A STUDY OF ALLOTMENTS AND SMALL LAND PLOTS: BENCHMARKING FOR VEGETABLE FOOD CROP PRODUCTION

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ABSTRACT

This study seeks to benchmark financial efficiencies for vegetable food crop production and to demonstrate that local vegetable food crop growing is a viable option. The work identifies techniques for communities to increase sustainability on small land plots in Wales [UK]. Initial research shows limited availability of systematic data on harvest quantities and financial returns for small scale growing of vegetable food crops. When interviewed, 37 growers from an initial total of 40 were either reluctant to provide, or had failed to keep, written records of vegetable production, their costs and sales statistics. The information provided by the 37 for comprehensive personal interview questionnaires is mainly derived from memory. Organic registered growers are notionally required to keep precise production and other details by the Department for Environment Food and Rural Affairs. Analysis of the memorised data showed in most instances that outputs generated were not sufficient to support inputs. This study highlights the difficulties of collecting and collating sufficient accurate data and systematic to establish reliable benchmarks for small agricultural enterprises. Data Envelopment Analysis software initially identifies efficient and inefficient producers from the data collected but a simpler more readily understandable analysis system is now used which identifies changes in input variables needed to gauge efficiency. This study is set against a theoretical examination of global economic events that combine to discourage localisation. The overall aim is to show that in a global production framework there are hidden, deferred and obscured costs that make those processes unsustainable. Study of the produce of smallholdings and allotments in Wales allows some tentative conclusions to be drawn about appropriate benchmarks for local vegetable food crop production. This study is more important however, for the light it sheds on the current quality of data available for analysing small scale agricultural production and the general difficulties of conducting a survey to collect robust data, the analysis of which has policy implications for production, consumption and lifestyle.

DEDICATION

To

Anne

CERTIFICATE OF RESEARCH

This is to certify that, except where specific assistance is attributed and reference is made, the work described in this thesis is that of the candidate. Neither this thesis nor any part of it, has been presented, or is currently submitted, in candidature for any degree at any other University.

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GLOSSARY OF TERMS/ABBREVIATIONS

DEFRA Department for the Environment, Food and Rural Affairs

LANTRA Is not an acronym but a term used to describe organisations under the auspices of The Royal Agricultural Society of England. These include The National Training Organisation for the Land-Based Industries; Lantra Trust and Lantra House National Agricultural Centre.

UK United Kingdom

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CHAPTER 1

INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1 Rationale

Land is a finite resource and fresh UK grown food should be considered as an important factor in land use.

1.2 Study purpose

This thesis will examine the establishment of benchmarks for vegetable food crop production within the UK, and particularly in Wales. The work will investigate a variety of vegetable food crop growers within Wales, in order to develop benchmarks for other growers and potential growers of vegetable food crops. The aim will be to provide financial efficiency recommendations for vegetable food crop growers to encourage sustainability through localisation. To be sustainable all practices should follow a number of criteria which have been discussed widely since the publication of the 'Brundtland Report' – Our Common future [1987], to include social, environmental and economic issues. The latter is often not considered as a major component of sustainability, but if vegetable food crop growers strive to follow organic methods and wish to be sustainable, their practices need to be financially efficient. The benchmarks from this work will provide the framework for vegetable food crop growers to be financially viable.

Thus, the aims and objectives of the work are as follows.

1. To investigate the environmental issues affecting vegetable food crop production in the UK.

2. To identify and review the main production methods adopted in the UK for growing vegetable food crops.

3. To evaluate organic methods of vegetable food crop production in the UK

4. To develop a series of benchmarks for financial efficiency using data from a variety of vegetable food crop growers in Wales which can be used by both existing and future potential vegetable food crop growers.

1.3 Contribution to Knowledge

The main contribution to knowledge from this work will be the development of a comprehensive interview questionnaire to provide a reservoir of detailed input and output data of the commercial aspects of vegetable food crop production. The data analysed by Banxia Data Envelopment Analysis software and other analytical programmes will produce results for use as a tool to develop benchmarks for efficient vegetable food crop production. Other data gathered during the research could be similarly used to establish benchmarks for other aspects of vegetable food crop production.

1.4 Chapter Structure

To meet the above aims and objectives this thesis encompasses nine chapters. This chapter starts the literature review by discussing localisation, the ecological footprint and social cohesion resultant from communal activities connected with vegetable food crop production. The affect of food transportation is also considered

1.4 1 Chapter Two Structure

Chapter 2 will discuss vegetable food crop production, importation and distribution methods for both vegetable food crops and other foodstuffs. Farming for vegetable food crop production by various methods including hydroponic, intensive and integrated methods will be examined. (with the exception of organic growing that will be explained in a separate chapter). Agri-chemical manufacturing, distribution and subsequent application to land and crops to the detriment of water supplies and as a contributor to soil erosion, and allegedly injurious to human and animal health will be examined. The monetary costs to remedy the pollution caused by intensive agricultural practices will also be discussed

1.4.2 Chapter Three Structure

Chapter 3 will describe organic production in the late 20th century and provide a brief history of the Soil Association and an overview of organic registration and regulations for growers. Appendix 1 will provide a description of all Department for Environment Food and Rural Affairs authorised registration bodies. The same appendix also describes the Wholesome Food Association in detail and explains the Wholesome Food Association's growing system which follows organic principles used by small growers unable to expend the capital required for registration through a Department for Environment Food and Rural Affairs approved body. Increased demand for organic vegetable food crops will be discussed and an overview of changes within the retail sector will be reviewed.

1.4.3 Chapter Four Structure

Chapter 4 will review small-scale vegetable food crop production on allotment sites and provide a brief history of allotment gardening activities. Details of an experimental vegetable food crops production scheme in 1975 that established a guide to the quantity of vegetable food crops that could be raised on a single 100 feet by 30 feet ($333m^2$) plot of land will be considered. Subsequent research by Perez-Vazques [2002] which discussed crop yields from three allotment plots will be examined although the work purpose was allotment futures and not benchmarking from any perspective. Work by Vazques [2002] is informative and relevant to this research. The relevance of legislation pertinent to allotment use and the possibility of commercial activity from such plots will also be considered.

1.4.4 Chapter Five Structure

Chapter 5 explains the research methodology and will explore the design of a benchmark study. Benchmarking and its uses will be defined from different perspectives. A framework will be decided for compilation of a detailed personal interview questionnaire. Testing of the questionnaire with a small sample will be discussed before a full survey within an established peer group is conducted. The peer group will be selected from lists of various organic and non-organic vegetable food crop producers and allotment gardeners. The input and output data obtained will be used for detailed analysis to establish benchmarks for small scale vegetable food crop production.

1.4.5 Chapter Six Structure

Chapter 6 will discuss the selection and testing of software for use in the final analysis of inputs and outputs to establish the benchmarks required for this study. To evaluate the most appropriate and efficient cultivation methods for use as benchmarks by potential vegetable food crop producers the Banxia Data Envelopment Analysis Software System will be tested on selected economic variables obtained from the sample. It is anticipated that the primary results of analysis using Data Envelopment Analysis Software will identify inefficient vegetable food crop producers within peer group of growers. The system will compare inputs and outputs of each of the sample on a like for like basis. Each efficient grower's performance will be shown graphically as a reference set to produce potential guidelines for the inefficient grower to follow. Each comparison will be shown as a separate figure in graphical and tabular format and will be discussed on an individual basis. The establishment of a 'standard' or the 'best of the best' grower or growers amongst any peer group on which to base benchmark criteria will undoubtedly prove to be a difficult task The efficient producers within the sample will represent the benchmarks for future production of vegetable food crops. Alternative analytical methods will also be examined to ensure that the process used will be both accessible and readily understood by simple reference. It is anticipated that more than one method of analysis could be used in the benchmarking process.

1.4.6 Chapter Seven Structure

Chapter 7 will discuss the conclusions obtained from this study.

1.4.7 Chapter Eight Structure

Chapter 8 will outline recommendations for future study.

1.4.8 Chapter Nine

Chapter 9 is the complete list of references and bibliographic details.

1.5 Localisation

Hines [2002] alleges that George Monbiot, in his book Captive State, misrepresented the concept of localisation by advocating a change from globalisation to a system of world parliament with 600 representatives each representing 10 million constituents. The process advocated by Monbiot [2000] would involve measures to transform the present World Trade Organisation into a Fair Trade Organisation; democratise the United Nation General Assembly to represent each nations vote according to the number of people it represents and to create an organisation to discharge trade deficits to prevent debt accumulation. Hines [2002] argues that localisation is a process which reverses the trend of globalisation by discriminating in favour of the local in the context of 'local' being part of the nation state to ensure that all goods and services that can reasonably be provided locally should be and that Monbiots' [2000] proposition as a solution to the problems of Globalisation has in it the seeds of destruction for the alternative he advocates as localisation. The policies for bringing about localisation states Hines [2002] are ones which increase the control of the economy by communities and nation states. Hines [2002] cites seven basic steps to localisation. These seven steps and Monbiots' four above are academic arguments which the layman may or may not understand. As the principle purpose of this thesis is localisation of vegetable food crop production using the benchmarks established within it the Hines versus Monbiot argument only partly applies and will not be dealt with further here.

It is not intended that UK farmers should be deprived of sales generated from local community vegetable food crop production by small or indeed larger scale growers. Benchmarks discussed in this thesis will encourage profitable vegetable food crop production to the detriment of foreign imports and, more importantly, reduce emissions from transportation by road and air. The UK balance of payments deficit should also be considered. At the same time social cohesion within communities could be considerably relevant. Indeed, the whole ethos of localisation is relevant to the ecological footprint concept.

1.5 1 Localisation and existing vegetable food crop production methods

Discussions in chapter 2 will show that the income of farmers and growers has fallen because of imports and the business methods of large retail groups. Increase of outputs and reduction of inputs will enhance profitability in any UK enterprise especially if the produce is sold locally. The Institute of Science in Society [2005] states that 'money spent with a local supplier is worth four times as much as money spent with a non-local supplier'…'Buying food in local farmers' market generates twice as much for the local economy than buying food in supermarket chains' 'small farms are two to ten times more productive than larger farms'. More local production could manifest in more employment opportunities too. UK production of vegetable food crops could benefit the UK balance of payments deficit referred to in chapter 1 section 5 above. More importantly local vegetable food crop production within the UK by any cultivation method could reduce emissions of CO_2 from transportation of vegetable food crops either from diverse corners of the UK or from foreign countries including the European mainland as discussed this chapter. However, as discussed in sections 2.4, 2.4.1, 2.4.2 and 2.4.3, it is apparent that the manufacture, transportation and application of chemical substances to increase vegetable food crop yields can be detrimental to human and animal health and soil sustainability. On this premise it should be considered that localized vegetable food crop production should be practiced using methods described in chapter 3 section 3.2.3 using benchmarks for maximum profitability.

1.5.2 Ecological Footprint

Wackernagel et al [2002], is credited with developing the concept of the ecological footprint in 1996. 'The ecological footprint is a tool for measuring and analysing human natural resource consumption and waste output within the context of nature's renewable and regenerative capacity (or bio-capacity)' 'It represents a quantitative assessment of the biologically productive area (the amount of nature) required to produce the resources (food, energy and materials) and to absorb the wastes from the residents of a country or a city over the course of a year' [Venetoulis et al 2004]. In 2003 the World Wildlife Fund Scotland [2003] defined the ecological footprint as 'a measure of the mark we leave on the natural world that sustains us'. 'Quite simply, it considers how much land and sea are needed to provide humankind with the water, energy and food that is needed to support our lifestyles' 'It helps humankind to judge how sustainable their lives are, and what changes are needed to improve the quality of life' [World Wildlife Fund 2003] 'The ecological footprint concept was created in the early 1990's and is now in use in many countries at national and local levels to establish cost effective management of resource flows, to provide clues to ways which we can reduce our impact on the wider world (for example, Mexico, US, Canada, the Netherlands Denmark, Sweden Norway, Italy, Spain, Australia and Wales' [World Wildlife Fund 2003]. Many large cities in the UK have commissioned Environmental footprint reports, including the Welsh Assembly Government who commissioned the World Wildlife Fund to submit an ecological footprint report specific to Wales which was researched and prepared by a specialist company Best Foot Forward and presented in 2002 [World Wildlife Fund 2003]. A press release from Centre for Business Relationships at Cardiff University [2003] states that Northwood was appointed to carry out a study of the ecological footprint for the City of Cardiff to be completed late 2004. The Report was published in March 2005

An Ecological Footprint offers society an empirical tool that could be used as guidance towards sustainability by influencing local policy decisions relative to all aspects of development including the, perhaps, most damaging; agriculture and transport. An Ecological Footprint cannot change society's activities on it's own but is surely a step toward a process of change. At a seminar of the Welsh Assembly Government [2002] delegates heard that the average citizen in Wales has an European Community Ecological Footprint capacity of 5.2 (hectares) while the average American requires 9.6 hectares to support their lifestyles [Bishop et al 2002]. If everyone on the Planet had consumption patterns like people in Wales there would need to be nearly two additional Planets to sustain the people of Wales [The Footprint of Wales 2002]. The use of small vacant land plots and unused allotments for vegetable food crop production using developed benchmarks for more financial efficiency, and also made available to existing producers, could help reduce the Ecological Footprint for Wales because such activity would provide food which at present is imported and often transported over great distances.

The concept of Ecological Footprints has further developed to encapsulate a process defined as Ecological Footprint Accounts. 'Ecological Footprint Accounts compute sustainability in specific and understandable terms by using the best available scientific data'. 'They allow individuals, policy analysts, organisations, and governments to measure and communicate the economic, environmental, distributional and security impacts of natural resource use' [Ecological Footprint Analysis 2001]. On this basis, the natural unused resource of small vacant land plots and allotment sites should be taken into account as a sustainable asset in Wales.

1.5.3 Social Cohesion within Communities

Shuman [1998] provides a simplistic definition for community and its needs as 'A community in which people know and care about each other is the basic building block for all other civilised activities, whether commercial, political, social or spiritual. If we cannot care about our neighbours, we will never develop the capacity to care about our nation or world. And there is no better expression of caring than to create a local economy which meets the basic needs of every one of our neighbours, and to help other local economies throughout the world to do likewise'. Local economy that stimulates local enterprise is the backbone of localisation. Other important elements include good housing, schools, shops, employment and training opportunities and other facilities within easy reach by public transport. The inclusion of local agricultural practices could provide habitat for wildlife, and preserve water and soil quality in an environment involving a wide range of activities including credit unions, re-cycling schemes, self-build groups to promote sustainability. Communal vegetable food crop production to provide healthy diet and exercise could also make significant contribution to physical, mental and social well being in the populace. 'It is estimated that up to a third of deaths from cancer and heart disease could be prevented by better diet – indeed, evidence suggests that increasing fruit and vegetable consumption is the second most effective strategy for preventing cancer after stopping smoking [Kearney 2004]. These communal activities need to have broad social aims, to be financially viable and owned and run solely by local people.

1.5.4 Transport Modes

The volume of vegetable food crops imported into the UK from the European Union alone increased by 58.10% over the period between 1998 and 2001 [Mintel 2003]. However, the monetary value of the European Union imports only increased by 23.2% [Mintel 2003]. Much vegetable food crop imports from the European Union is of produce available from growers in the UK as illustrated in Table 2.1 chapter 2 page 22.

Transportation of vegetable food crops and other food items within the UK has been the subject of considerable research by Paxton [1994] and Lang [1999]. Similarly, much work has been completed within the United States of America by Pirog. et al [2001]. "Food is becoming *the* issue in the transport debate". "The food economy accounts for a large proportion of the UK's road freight and, with the 'Globalisation of Trade' more food is being imported than ever before' [Paxton 1994]. Jones et al [2003], discuss the Slow City and Smart Growth movements and advocate 'encouraging the use and production of local foodstuffs using eco-sensitive methods'. The author also believes that a common sense approach to production and purchase of vegetable food crops is surely to grow, sell and then consume as near as possible to source for the whole of society to attain a combination of sustainable and economic benefit.

The importation of foodstuffs, which could be produced in the UK, makes a considerable contribution to the trade deficit and, more importantly, to multifarious pollution problems from transportation. In 1990, 'Road transport accounted for approximately 20% of the UK's carbon dioxide (CO_2) emissions, 50% of nitrogen oxides (N_2O), and almost all emissions of lead (Pb) and carbon monoxide (CO)'Paxton [1994]. 'It is estimated that air pollution from road transport accounts for £2.800 billion of damage annually in the UK' [Paxton 1994]. 'The social costs of road use, including road traffic accidents and land used for car parks, were estimated in 1991 to be at least £22.900 billion' [Paxton 1994]. 'This is twice the revenue the government obtained from the taxes paid by road users' [Paxton 1994]. Here in the UK the manufacture and transportation of agro-chemicals used in mono-culture and intensive vegetable food crop production generates unacceptable quantities of CO_2. In addition to the emission of greenhouse gases during fertilizer and pesticide manufacturing processes, road transport is used for delivery purposes. Pesticide distributor vehicles each travel 30 to 40 thousand miles per year, to reduce the need for on-farm storage [British Agro-chemicals Association 2000]. 'At each of the 200 pesticide/fertilizer distribution depots across the UK, there are two drivers, and the total distances travelled by each driver for delivery mileage is between 30 and 40 thousand miles per annum British Agro-chemicals Association 2000], this equates to some 12 to 16 million miles of road based transport annually in the UK' [British Agro-chemicals Association 2000]. The pollution from vehicle use over these distances is considerable and, according to Simms et al [2000], road vehicles account for 80% of CO_2 emissions from transport.

Movement of food by road consumes 2,890 kilojoules (KJ) of energy per tonne per kilometre, emits 207 grams per tonne per kilometre of $C0_2$, 0.30 grams of hydrocarbons (HC), 3.6 grams of N_2O and 2.40 grams of CO all of which are greenhouse gases [Lucas 2001]. Air transportation presents an even more damaging scenario, where primary energy consumption of fossil fuels is stated as 15,839 KJ per tonne per kilometre travelled, with total emissions of 1,260 grams CO_2, 2.0 grams HC, 3.0 grams of Volatile organic compounds (VOC), 5.5 grams of N_20 and 1.4 grams CO_2 per tonne per kilometre [Pirog et al 2001]. Localised production, distribution and consumption could considerably reduce this problem.

By weight alone, fruit and vegetables account for the largest category of any UK air freighted import [Lucas 2001]. Trade related UK imports of fruit and vegetables by plane, Lucas [2001] stated, had, "between 1980 and 1990 increased by 90%, and further, UK air freight (imports and exports) grew by about 7 % a year in the 1990s and is expected to increase at a rate of 7.5% a year to 2010".'One shopping basket of imported produce could have travelled 241,000.00 kilometres (km) (150,000.00 miles) and released as much CO_2 into the atmosphere as an average four-bedroom house does through cooking over eight months' [Lucas 2002]. 'For every calorie of carrot flown into the UK from South Africa, 66 calories of fuel is used' [Lucas 2002]. Food transported into the UK in aircraft causes very high levels of pollution, "for example, a two minute DC10 take-off produces the same quantity of nitrogen oxides as driving 21,539 cars one mile, at 30 miles per hour" [Sustain 1999].

However, marine transport of food emits 50 times less CO_2 than transport by aviation [Sujata 2002]. On the basis of the above issues we should be mindful of the localisation theory that considers shifting away from intensive, industrialised methods of production, which are dependent on ever increasing transport and international trade. The theory should, and could, be applied to all manufacturing processes, but here is considered pertinent to vegetable food crop production. In the context of vegetable, and perhaps, fruit production, localisation theory implies that sustainability in food crop growing could be achieved through transition by a cultural epidemic gradually leading to economic reality within communities. A good example could be farmer's markets connecting food producers with consumers to create local employment and other local economic benefit input. Community organic vegetable and fruit crop growing could also provide low cost food as a contribution to holistic local environmental gain. An ongoing affect of both examples would be the reduction of food miles and consequently atmospheric pollution levels. A far wider affect could be evident in the developing World. Cash crop production for export contributes to lack of self-sufficiency and environmental damage in poorer countries. Further, subsidised production support within UK could be replaced by payment for more extensive organic farming marketed locally accompanied by shift away from high-technology intensive agriculture with high levels of pesticide use and dependence on perceived dangerous technology associated with genetic modification.

CHAPTER 2

VEGETABLE FOOD CROP PRODUCTION

Chapter 2: Vegetable Food Crop Production

2.1 Introduction

This Chapter discusses land use and the methods of production and distribution of imported and home produced vegetable food crops. The effects of residual chemicals in food and their run off from land into water-courses and the manifestation in animal and human life, to the possible detriment of health is also discussed.

2.2 Issues relating to Vegetable Food Crop Production in the UK

2.2.1 Land Use

The total land area of the UK excluding Northern Ireland is 229,334 kilometers^2 of which 185,480 kilometers^2 is in agricultural use [Office for National Statistics 2002]. Of this it is estimated that 167,275 kilometers^2 is under intensive or semi-intensive non-organic agricultural use and therefore subjected to the application of synthetic pesticides, herbicides and fertilizers [Pretty et al 2001]. For Wales the total land area is 20,778 kilometers^2 of which 1,633 kilometers^2 is in agricultural use [Welsh National Assembly 2004].

However, each year 400 kilometers^2 of UK farmland disappears under buildings, roads and leisure areas [Crop Protection Association 2000]. The author has not been able to locate separate statistics for Wales but contends that, to reduce this annual land loss, commercial premises, housing development and leisure facility construction should primarily be completed on brown-field sites; current technology can facilitate bio-remediation of larger contaminated areas. Use of brown-field sites for development in the UK could reduce the need for annual increments of food importation by providing more agricultural output.

There is a need for more localised UK produced food for employment, health and monetary benefit: especially vegetable food crops. The effects of imported goods on the environment are discussed below and in section 2.2. Contaminated land is defined by Section 78A (2) of Part 11A of the Environmental Protection Act 1990 as "any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- pollution of controlled waters is being, or is likely to be caused".

The Part 11A regime came into force in England in April 2000 through Statutory Instrument 2000 No227 The Contaminated Land (England) Regulations [2000], and Wales in 2001 through The Contaminated Land (Wales) Regulations [2001]. It requires local authorities to identify contaminated land in their area and to ensure effective remediation. The Environment Agency estimated that in 2002 there could have been between 5,000 and 20,000 contaminated sites within England and Wales and it will be 2006 before the first round of inspections is completed [Hall 2002]

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Mis-used land is a difficult element to identify and define, where small, and indeed, seemingly large areas of vacant neglected land and derelict allotment plots are noticeable in both urban and rural areas. The author has observed that many such sites around the South Wales (UK) area harbour illegally dumped furniture and other assorted unsightly detritus. Research has shown that in England approximately 20% of allotment plots were vacant [Quality Environment for Dartford 2002]. It has not been possible to locate research assessing derelict and vacant land within Wales, but from observations and discussion the author has found that many plots exist which could be used productively by community enterprises including schools. It is proposed that the use of vacant land plots for the provision of education to include practical horticultural skills for students of all ages could benefit society generally by replacing lost abilities and generating understanding of the natural environment. An appreciation of the origin of vegetable food crops could encourage consumption of healthy natural foods.

2.2.2 Global Issues

Globalisation in the rural and agricultural sphere with food trade linkages, transportation and production methods coupled with the rise in trans-national capital, has encouraged the UK public to consume imported vegetable food crops when they are out of season within the UK. But it is often apparent that the consumption of imported vegetables continues at times when indigenous crops are readily available. Even during the harvest time for UK vegetable food crops it can be observed that imported peas, asparagus, runner beans, spinach, new potatoes, cauliflower, courgette, carrots, onions and salad products are available in most supermarkets. UK produced potatoes, swedes and carrots can be stored for long periods in on-farm clamps. Clamps are usually under cover areas, with open sides to allow air circulation, where potatoes are stored in layers of straw and covered to keep out light and frost with weighted carpet waste or tarpaulin. Onions require covered enclosed dry areas. Table 2.1 on page 22 contains a complete summary of the comprehensive range of UK grown vegetables available on a regular basis throughout the year.

Globalisation has encouraged some countries to cultivate cash crops for export to richer industrial countries including the UK, to the detriment of localisation in the places of origin and the receiving countries. Crops formerly grown by peasant communities for home consumption have been replaced by crops for cash generating export [Shiva 2000].

Global food production and trade is thought to consume more fossil fuel than any other industrial sector [Shrybman 1999]. Huge trans-national companies have taken over and now monopolise food production and distribution [Shrybman 1990]. Since the mid 1990's there has been a wave of global mergers and acquisitions in the food and manufacturing sector – between 1993 and 1995 there were almost 1500 global mergers and acquisitions within the food and drink industry world-wide [Shrybman 1999]. More people should be encouraged to grow more food for themselves in gardens, allotments and other small land plots to sponsor UK sustainability that reduces the pollution from all modes of transport conducting import and export logistics.

Table 2.1: UK Vegetable Crop Availability

Month Available	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crop												
Artichoke Globe						x	x	x	x			
Artichoke Jeru	x	x	x	x						x	x	x
Asparagus					x	x						
Beans broad						x	x					
Beans Runner						x	x	x	x			
Beans Kidney						x	x	x	x			
Beetroot	x	x	x	x	x	x	x	x	x	x	x	x
Broccoli Calabrise						x	x	x	x	x		
broccoli Sprouting			x	x	x							
Brussels Top	x									x	x	x
Brussels Sprouts	x	x	x	x						x	x	x
Cabbage Janking	x	x	x	x						x	x	x
Cabbage Drumhead								x	x	x	x	
Cabbage Spring	x	x	x								x	x
Cabbage Red	x	x										x
Carrot	x	x	x	x	x	x	x	x	x	x	x	x
Cauli	x	x	x	x	x	x	x	x	x	x	x	x
Celeriac	x	x	x						x	x	x	x
Celery				x	x	x	x	x	x	x	x	x
Chicory	x	x							x	x	x	x
Chinese Leafs				x	x	x	x	x	x	x	x	
Courgette						x	x	x	x	x		
Cucumber			x	x	x	x	x	x	x	x		
Endive				x	x	x	x					
Kale	x	x	x	x	x						x	x
Leeks	x	x	x	x				x	x	x	x	x
Lettuce	x	x	x	x	x	x	x	x	x	x	x	x
Marrow						x	x	x	x	x		
Mint				x	x	x	x	x	x	x		
Mushroom	x	x	x	x	x	x	x	x	x	x	x	x
Mustard and Cress	x	x	x	x	x	x	x	x	x	x	x	x
Onions	x								x	x	x	x
Parsley				x	x	x	x	x	x	x		
Parsnips	x	x	x	x					x	x	x	x
Peppers					x	x	x	x	x	x		
Peas					x	x	x	x	x			
Potatoes New						x	x	x				
PotatoesMaincrop	x	x	x	x	x				x	x	x	x
Pumpkin								x	x	x		
Radish				x	x	x	x	x	x	x		
Seakale	x	x	x									x
Shallots	x								x	x	x	x

Development of the localisation theory per se (discussed in chapter 1 section 5 and chapter 3) involves pursuance of more self-reliant local economies. As far as the author can ascertain, horticulture, unlike main-stream agriculture, is not subsidized – neither is pig or poultry production although there are payments in the form of development subsidies to encourage the expansion of organic production under The Organic Farming Scheme [Department for Environment Food and Rural Affairs 2002] which is implemented through the Department of Environment Food and Rural Affairs. Localisation can be achieved through local work and the use of local resources to meet local needs to prevent imports into and exports out of local areas and needs to be financed on a local basis. The process needs to include local recycling and the re-use of local materials and equipment. Globalisation removes consumers from contact with producers because regional and global agriculture aims to produce the cheapest product by mono-culture and intensive methods for distribution to a Global market. The net result is the defeat of localisation in that local food systems providing fresher produce by sustainable methods become uneconomical for small farmers and local producers within urban and rural communities.

2.3 Agricultural Methods Overview

This thesis is primarily concerned with vegetable food crop production within the UK. Some vegetable food crop production forms part of larger farming or horticultural enterprises and inevitably these other activities will be considered whilst discussing the particular interest of this thesis. An example could be an organic farmer growing vegetables to partly feed a dairy herd. Another anomaly may be an enterprise involved in green waste collection and composting.

Vegetable food crop production within the UK, and other places such as Africa, India, Asia, from which imports are sourced, is attained by various cultivation methods. All methods except organic will be discussed in this chapter. Non-organic conventional farming can be defined as 'Animal and crop husbandry, which maximizes profitability using external inputs applied within permitted limits to overcome constraints on production' [Crop Protection Association 2000]. Integrated Crop Management is a mixture of intensive and non-intensive methods, and both are discussed below. Hydroponic growing is widely applied in the UK to certain crops, including capsicum and tomatoes, and can be considered as a separate issue. Smallholding and allotment cultivation are integral parts of life in the UK for some individuals and households. Sustainability through local vegetable food crop production is both historical and forms part of local culture in the UK and is therefore relevant to this research. Each of the common intensive and semi-intensive methods is described below. (Organic production and its importance for the prevention of pollution to watercourses, the poisoning of wildlife and damage to human life from chemical use in intensive agricultural practices: is described in chapters 3 and 4). Allotment and smallholder cultivation is usually conducted by mixed methods and although at times organic growing is practiced on an un-registered basis the two varied producer types will be described in chapters 3 and 4.

An extrapolation of farming history and facts from Douthewaite [1996], Selincourt [1997] and Tansey et al [1995] describes 'traditional' as the mixed farming method which preserves wild-life, habitats and hedges and which, during pre-industrial times, were a very local activity as farms were closed units, stable, and sustainable ecological systems [Tansey et al 1995]. Organic farming and growing is that which is registered in the UK with the Advisory Committee on Organic Food and Farming through The

Department of Environment Food and Rural Affairs European Community Council Regulations.2092/91. Organic farmers, growers, processors and packers adhere to strict standards which avoid the use of pesticides, insecticides, fungicides, growth hormones and regulators or genetic modification under European Community Council Regulations. 'All food sold as being organic must come from growers, producers, processors or importers who are registered and subject to inspection' [Jones et al 2001]. Conversely, non organic conventional farming and crop growing 'maximizes profitability using external inputs applied within permitted limits to overcome constraints on production' [Crop Protection Association 2000]. But, according to the European Conservation Agriculture Federation (European Community Agricultural Federation) Annex 1 [2001] 'conventional agriculture is generally harmful to the environment' 'These (conventional) techniques considerably increase soil deformation by compaction, erosion and river contamination with sediments, fertilizers and pesticides'. Integrated Crop Management is defined by the Crop Protection Association as a middle way approach to intensive conventional farming and growing practices [Crop Protection Association 2000]. The Department for Environment Food and Rural Affairs defines the practice as a method to 'balance the economic production of crops with measures that preserve and enhance the environment' [Pesticides and Integrated Farming Department for Environment Food and Rural Affairs 2000].

Other areas of vegetable food crop production in which various methods of cultivation are used are allotment sites and domestic gardens. There is minimal systematic data available for allotment sites, particularly in Wales, but it is estimated that in 1997 there were 30,000 allotment plots within Wales [Crouch 1997]. According to Statistics for Wales [Welsh National Assembly 2004] there are some 1.28 million dwellings in Wales although research to gauge how many have productive gardens has not been included in this thesis. Little is known of production rates for vegetable food crop production within private gardens. Other areas of vegetable food crop production within the UK are community gardens within urban projects and medical foundations discussed in Chapter 3. The 1975 Royal Horticultural Society experiment at Harlow Carr (discussed in chapters 4 and 6) is the only known rigorous record of vegetable food crop produce harvested on allotment plots [Stokes 2005]. It appears that in recent decades many allotments have become unused and derelict, and recently a strong movement involving The Allotment Regeneration Initiative is sponsoring a revival in the tradition of allotment use.

2.3.1 Hydroponic horticulture

Plants can be grown in a medium other than soil by a method known as Hydroponic (water horticulture) which is used in various ways to produce vegetable food crops. 'The method of growing plants in water to which special chemicals are added, rather than growing them in earth' [Cambridge Advanced Learner's Dictionary 2005]. Hydroponic systems require extensive capital equipment and dependence upon chemical substances, although there are organic methods of using the system for growing. The growing medium can be stable clay, pebbles, vermiculite, perlite from volcanic rock, coir fibre from coconut husks or rock-wool from glass fibre which is moulded into cubes. Each growing medium is designed for a specific use, either in tanks or pots with different advantages [Ponic Hydroponics 2004]. The growing medium is used to anchor the plant roots and hold the nutrients for plant growth; nutrients can be selected from varieties containing only natural plant extracts or chemically produced substances [Ponic Hydroponics 2004]. Pest control can be by specially blended plant oils or live predators, sometimes supplied by Evergreen Hydroponics [Evergreen Hydroponics 2005], or by chemical pesticides [Ponic Hydroponics 2004]. As an aside, it is interesting to note that an estimated 65% of all fruit and vegetables purchased from UK supermarkets are grown in hydroponics systems, including lettuce, capsicum and tomatoes [Esoteric 2004]. Esoteric [2004] also claim that 100% organic hydroponic growing is more organic than growing outdoors, and enables twice to ten times the yield in half the time depending upon crop type. However in the literature available at this time. Esoteric [2004] does not provide a detailed explanation to verify this claim.

2.3.2 Intensive conventional farming

Intensive conventional farming can be defined as 'animal and crop husbandry which maximises profitability using external inputs applied within permitted limits to overcome constraints on production' [Crop Protection Association 2000]. The application of chemical products to intensify crop growth is described in Section 2.4 below. However, some traditional mixed farms do exist in the UK. An extrapolation of farming history and facts from Douthwaite [1996], Selincourt [1997] and Tansey et al [1995] describes 'traditional' as "the mixed farming method, which preserves wild-life habitats in hedges, and practices the avoidance of chemical application to land and crops", which are not registered organic producers. It is known that vegetable food crops have very different nutrient requirements to cereals and grazing land and are usually cultivated by specialist horticulturists distinct from cereal and animal husbandry production. Vegetable food crops have short growing seasons and are generally harvested before producing seed – 'this means that nutrients must be in the ground and available for uptake by the plant during the high demand period of growth - for field vegetables this may be as much as 250 kilograms dry matter per hectare per day' [Hardter 1998]. 'Vegetables require five times the concentration of soil potash (K_2O) than any other crop' – 'to cultivate healthy vegetable food crops balanced fertilisation is the key' [Hardter 1998]. All commercial vegetable food crop production, with the exception of organic, is subjected to chemical fertilizers and pesticides and therefore Poulton et al [2001] suggest 'that the production of some vegetable food crop cash crops raises concerns about inappropriate and uncontrolled pesticide use'. Chemical application to soil and crops is regulated in UK under various directives including The Pollution Prevention and Control (England and Wales) Regulations [2000].

If the example of Indonesia is considered, subsidies for fertilizers have reached 68% of world prices; as a result, consumption of fertilizer has increased by 77% (12.3% per year between 1980 and 1985) [Barbier 1987]. This reveals a situation that could indicate over application of chemical substances to soil and crops. Chemical usage patterns in Indonesia may have changed by the end of the last millennium, but the author has not been able to find more recent statistics than those cited above. It raises the question of excessive fertilizer and pesticide usage within many developing or third world countries engaged in the production of vegetable food crop cash crops. Many of the vegetable food crops imported into the UK could contain more than the permitted levels of residual chemicals. According to European Conservation Agriculture Federation Annex 1 [2001] 'conventional agriculture is generally harmful to the environment'-'these techniques considerably increase soil deformation by compaction, erosion and river contamination with sediments, fertilizers and pesticides' [European Conservation Agriculture Federation Annex 1 2001]. In section 2.4.1 below the resultant pollution from chemical application to crops and land is detailed. Section 2.4. this chapter describes the rate and type of chemical usage employed to promote rapid growth.

2.3.3 Integrated crop management

Cynics may opine that the integrated crop management method has been created by the agri-chemical industry through the Crop Protection Association in co-operation with the Department for Environment Food and Rural Affairs, to forestall the increasing movement toward organic agriculture. Coupled with other protests and revelations by environmentalists and consumer groups, the Crop Protection Association and Department for Environment Food and Rural Affairs may consider such activities a threat to profitability. Integrated Crop Management, is a farming method designed by the Crop Protection Association as a middle way alternative to intensive farming methods, 'to balance the economic production of crops with measures that preserve and enhance the environment' [Department for Environment Food and Rural Affairs Pesticides and Integrated Farming Department 2000]. The Integrated Crop Management system allegedly uses pesticides and fertilizers more efficiently than conventional intensive farming enterprises. 'Integrated Crop Management recognises that modern farming inputs, such as fertilizers, crop protection chemicals and fossil fuels, are necessary to produce high enough yields of good quality food at reasonable prices in an environmentally accepted way' [Department for Environment Food and Rural Affairs Pesticides and Integrated Farming Department 2000]. Integrated Crop Management, although presented as a middle way approach to intensive farming methods, is considered by the environmental lobby to be considerably less ecologically damaging. 'The Integrated Crop Management technique involves the integration of a range of farming practices in order to balance the economic production of crops, with measures that preserve and enhance the environment' [Department for Environment Food and Rural Affairs Pesticides and Integrated Farming Department 2000]. Integrated Crop Management practices make more efficient use of pesticides and fertilizers than conventional intensive arable farming. The system helps to minimise the potential adverse effects of such products on the biota. The Integrated Crop Management guide advises cultural and natural biological controls in what is regarded as a complex farming methodology, and offers advice through such organisations as Linking the Environment and Farming and The National Agricultural Centre [Department for Environment Food and Rural Affairs Pesticides and Integrated Farming Department 2000]. This summarises the system as 'using pesticides only where absolutely justified; to consider combining chemical and non-chemical controls; treat only when thresholds are exceeded where possible; use the right product at the right time and to seek expert advice if in any doubt as to what controls might be used'. Technology allows special equipment attached to agricultural machinery the capability of identifying plant life regarded as weed or crop that is fertilizer deficient, and to deliver the required amount of chemical substances to a specified area for control. However, although the Integrated

Crop Management system could be a step in the right direction for the preservation of natural capital, the use of any quantity of chemical substances can be harmful to all ecological systems. Following this approach, the practice of organic food crop production methods must be beneficial and therefore given every encouragement to prosper. One method would be to encourage small scale localised vegetable food crop production without chemical application, driven by research and initial grant aid to local communities.

The Crop Protection Association is a conglomerate of the largest chemical companies involved in agrichemical manufacture, forty-eight companies form the Crop Protection Association which has, it states, its own enforcement procedure through a code of practice to ensure compliance with Food and Environment Acts, including those set by The United Nations Food and Agricultural Association [Crop Protection Association 2000]. However, as will be seen in section 2.4.1 and 2.4.4 below, there is much concern and increasing evidence that chemical application to food crops generally is considered by many to be a major health problem for both human and animal well-being.

2.3 4 Waste from vegetable food crop Production

It is accepted that vegetable food crop production, as with all production processes, generates waste. Large retail outlets also generate waste with unsold vegetable and fruit produce and wrappings which have to be disposed of. The accepted method in vegetable food crop growing areas is to compost the waste and return it to the land as a natural fertilizer. Supermarkets and, indeed, other stores, restaurants and hotels have in the past removed bio-degradable waste to land fill operations for disposal. Perhaps not as a separate entity but mixed with non-degradable plastics metals and glass [Green Recycling of Organic Waste from Supermarkets 2000]. Supermarket waste is discussed below but the average person throws away £424.00 of fruit, vegetable food crop and bread yearly because consume by dates have elapsed [Waste and Resources Action Programme 2004]. In addition milk, cooked meat products, packet foods, cheese, prepared meals and unfinished bottles of wine are discarded for similar reasons [Waste and Resources Action Programme 2004].

In 2001, The Environment Agency issued generic Technical Guidance notes for external consultation on the requirements of Article 6(a) of the European Union Landfill Directive [1999/31/European Community] In England and Wales. The Directive is implemented through the Landfill (England and Wales) Regulations 2001, which were made under the Pollution Prevention and Control Act 1999. The Landfill Directive came into force in England and Wales on 16th July 1999. Part 6.2.3 of the document advises on methods for bio-degradable waste disposal. Other parts of the notes advise on diverse waste treatment techniques. Additionally Her Majesty's Government Statutory Instrument 1996 No 1527 is The Landfill Tax Regulations of 1996. The Landfill Tax Regulations were introduced in 1999, aimed at diverting waste away from landfill by charging for the disposal of waste to landfill. The tax in 2004 currently stands at £15.00 per tonne for active food and organic waste and £6.00 per tonne for inactive waste [The Land Fill Tax Regulations (as amended) 1996]. The landfill tax regulations permit up to 20% of the taxes collected by Landfill Operators to be offset against environmental projects. The Landfill Tax regulations were introduced to encourage the use of more sustainable waste management practices and technologies and the creation of partnerships between landfill operators and the local communities. Waste disposal companies and other organisations which dispose of waste are eligible to pay the tax. The rising costs of landfill disposal are then passed on to waste producers. As a consequence some supermarkets (Waitrose and Sainsbury in particular) have decided to create compost from their unsold food through an organisation known as GROWS an acronym for Green Recycling of Organic Waste from Supermarkets [Green Recycling of Organic Waste from Supermarkets 2002]. The process enables supermarkets to claim through the landfill tax credit scheme, which specifies use of monies for environmental project schemes [Green Recycling of Organic Waste from Supermarkets 2002]. The rebate of £11.00 per tonne for organic waste not disposed of in landfill could prove to be a profitable incentive when trials are completed [About Green Recycling of Organic Waste from Supermarkets 2002]. The Regulations are due to change in 2006 and at present details are not available.

In addition, to the requirement of supermarkets for organic waste disposal there are charitable organisations which include the 'FareShare' scheme involving the charity CRISIS and 'GroceryAid' [CRISIS 2002]. Food that has passed sell by dates is delivered to central depots and distributed to the homeless. CRISIS [2002] estimate that up to 500,000 tonnes of edible food is thrown away each year in the UK where there are 13 million people living in poverty [Vidal 2000]. The monetary value is put at some £50 million each year. Tesco and Sainsbury admit to each dumping £28 million of food per year, of which about 3,000 tonnes is collected by charities each year, but it is claimed the charities could handle much more [Crisis 2002].

2.4 Chemical application to land

The United Nations Sustainable Development Action Plan under Local Agenda 21 defines land as a finite resource and demands integrated planning and management [United Nations Council for Economic Development 2002] Climate change, poverty, bio-diversity and food security are all linked to soil which is a vital and finite resource [United Nations Council for Economic Development 2002].

Indeed, Wallstromm, [2002], states that soil protection is being recognised as an issue of importance by the European Union; cleaning up water and air, soil erosion, the decline in soil quality and the sealing of soil are major causes for concern across the European Union. In 2002 The European Union Environment Commissioner (Wallstromm) conceded, that soil is a sustainability issue, given that these trends are largely irreversible and that soil is vital for our own livelihood.

Systematic data of chemical usage in agriculture are essential to appreciate the need for vegetable food crop production by alternative methods. Indeed, the same should apply to all agricultural practice, including animal husbandry. The environmental costs in health terms to human and animal life, and the clean up costs resultant from run off, seepage into aquifers, soil degradation and atmosphere are illustrated in the section 2.4.4 set out below. Naturally fertilized and rotated crops could provide a natural and healthy diet without causing pollution and other problems. There has been much publicity by environmental organisations such as Sustain, World Wide Fund for Nature, Greenpeace and broad-sheet newspapers such as the Guardian, concerning the food system and chemical damage to health by cancer-causing, mutagenic or neurotoxin chemicals residual on and added to food products of all kinds. Growers of vegetable food crops, global multi-national companies and supermarket chains continue to dominate the market with products allegedly dangerous to human and animal health. Science could be correct in assuming safe levels of chemical intake but could it not be more propitious to err on the safe side and avoid such health risks. Quantities of chemicals applied to all agricultural and horticultural crops are considerable and cannot be described fully here.

Active pesticide ingredients sold to all agricultural sectors in UK in the year 2000 totalled 23,650.00 tonnes, and generated sales of £426.20 million for the chemical industry, nationally and internationally [Crop Protection Association 2001]. The 149 chemical 'Adjuvants' listed by United Kingdom Pesticides Guide [2001] are not themselves classed as pesticides, but require authorisation for usage [Her Majesty's Government (The Food and Environmental Protection Act) 1985]. The generic term 'pesticide' is divided into three specifics, which all contain adjuvant mixtures in addition to the active chemical ingredients, insecticide, fungicide and herbicide [United Kingdom Pesticide Guide 2001]. The term "pesticides" includes herbicides, insecticides, fungicides and masonry biocides, anti fouling agents and growth regulators [Crop Protection Association 2001]. Furthermore, pesticides contain Adjuvants, substances other than water, which enhance the effectiveness of a pesticide with which it is mixed [United Kingdom Pesticide Guide 2001]. These additives include mineral oil, vegetable oil, phenol acid, and synthetic latex, among many other substances [United Kingdom Pesticide Guide 2001].

Insecticide is a chemical substance, classes of which are illustrated below, applied to various crop types and soil, for the control of insect pests [United Kingdom Pesticide Guide 2001]. Fungicide is a substance for the control of fungal diseases on grain and vegetable crops and these chemicals are listed in inclusion with all other pesticides within [United Kingdom Pesticide Guide 2001]. Herbicidal pesticides are sub-divided for the control of weeds by type.

- Aphicide (controls aphids);
- Nemacide (controls nematodes);
- Lumbricide (controls worms);
- Acaricide (controls mites);
- Algicide (controls algae);
- Mosskiller (controls moss);
- Graminicide (controls grass weeds).

Of the 23,650 tonnes of pesticide discussed above, 8,231 tonnes were used on agricultural land during the year 2000 in the UK [Crop Protection Association 2001]. This equates to an average application of 9.17 tonnes per 0.01 Km^2 (1 hectare) (2.47 acres) over the 167,275 $Kilometers^2$ (1672 750 hectares) (4133.36 acres) of land in general agricultural use [Crop Protection Association 2001]. Over the same period (year 2000) the application of chemical fertilizers per 0.01 Kilometers ^{2} (1 hectare) (2.471 acres) of agricultural land, totalled 8.6 Tonnes [British Survey of Fertilizer Practice 2000].

The survey by British Survey of Fertilizer Practice [2000] notes that there has been a 20% reduction of fertilizer use (with the exception of sulphur, which is increasing) between 1991 and 2001, which is partly due to land set aside and uncultivated to provide wildlife habitats, farm price costs and increases in the cost of energy used in production. Sulphur (SO_3) is used to control infestation of red spider mite on beans, tomatoes and cucumbers which, when grown under glass develop mildew [British Survey of Fertilizer Practice 2000]. Systemic fungicide is known to kill worms, whereas SO^3 and CU will not, if correctly used [Hessayon 1998 and Bonar [1980].

Nitrogen (N), Phosphate ($P2_2O_5$) and Potash (K_2O) are applied to all crops. Sulphur (SO_3) is used solely for SO_3 deficiency in crops, such as oilseed rape, cereals and intensively cut grass which have a high SO_3 requirement [British Survey of Fertilizer Practice 2000]. SO_3 reserves have become depleted in some soil types, particularly sandy and shallow soils, because of continuing reduction in Sulphur Dioxide (SO_2) emissions from industrial sources, and the consequent decline in atmospheric deposition of SO_3 over the last 30 years between 1966 and 1996 [McGrath et al 1996]. Tables 2.2, 2.3, 2.4 and 2.5 below illustrate total fertilizer to land application of kilograms per hectare (0.01 kilometers^2) to all crops 1999 and 2000.

Table 2. 2 Application of Nitrogen (N) [British Survey of Fertilizer Practice 2000]

Year	Tillage Crops kg/ha	Grass kg/ha	All crops and grass kg/ha
1999	141	110	125
2000	149	99	123.

Table 2. 3 Application of Phosphate ($P2_2O_5$) [British Survey of Fertilizer Practice 2000]

Year	Tillage Crops kg/ha	Grass kg/ha	All crops and grass kg/ha
1999	45	20	32
2000	47	20	32

Table 2. 4 Application of Potash (K_2O) [British Survey of Fertilizer Practice 2000]

Year	Tillage Crops kg/ha	Grass kg/ha	All crops and grass kg/ha
1999	57	28	42
2000	55	26	40

Table 2. 5 Application of Sulphur (SO_3) [British Survey of Fertilizer Practice 2000]

Year	Winter Wheat kg/ha	Winter Barley kg/ha	Spring Barley kg/ha	Oilseed Rape kg/ha
1999	34	45	28	66
2000	49	45	39	68

It is known that the application of the above chemical substances is a primary cause of soil erosion, resulting in the breakdown of soil humus, and Selincourt [1997] observes that, in Southern England, annual soil erosion losses have been estimated to be between 2 and 40 tonnes per hectare. This provokes particular cause for concern, as it is known that the loss of 12 tonnes per year per $0.01 Km^2$ (1 hectare) reduces crop yield by 8%

[Douthewaite 1996]. It is also known that it takes between 100 and 2,500 years to build up a 25 mm depth of fertile soil. Human interference, mainly through agri-chemical application, can destroy this top layer of soil within less than a decade [Rivers 1988]. As a result of chemical substance application world-wide topsoil is eroding at the rate of 25 billion tonnes per year; which is approximately 7% of the world's soil every decade [Rivers 1988]. In the United States of America it is expected that in the 50 years from 1988, the annual grain harvest will be cut by 50 to 75 million tonnes from the 1998 total as a direct consequence of the loss of topsoil, one third of which is part of crop land in the United States of America [Rivers 1988]. Rivers [1998] also states that "elsewhere around the globe, the degradation of land due to soil erosion is expected to reduce crop production annually; the maintenance of healthy soil is thus becoming a matter for concern". The author has not been able to source similar research subsequent to Rivers [1988]. Soil erosion research will be necessary by 2038 at the latest to substantiate the predictions of Rivers [1988].

'Groundwater pollution and health problems raise particular problems in areas of low rainfall and few public services' [Poulton 2001]. These problems could also be created within the UK where chemical fertilizers and pesticides are in use. Small horticulturists and large producers of field vegetable food crops are under strict chemical usage controls, but run off into water-courses and residual compounds on foodstuffs may still cause health and groundwater pollution problems. 'It is estimated that 167,275 Kilometers^2 of the total UK agricultural land is under intensive or semi intensive non-organic agricultural use in the UK' [Pretty et al [2000]. 'Therefore this land is subjected to the application of synthetic pesticides, herbicides and fertilizers to promote rapid growth and increased crop yields, principally in monoculture situations within the UK' [Pretty et al 2001]. Ecosystem damage is mainly from harmful herbicidal chemicals. Organophosphates and organochlorines are deemed to be the most toxic according to Pretty et al [2000] and Hird [2000].

2.4.1 Intensive agri-chemical use and health

Agri-chemicals have been declared as highly toxic, according to Myhill [2003]. Myhill [2003] has been advising as an expert witness in two actions before the UK courts for damage to the health of two farmers suffering, she stated, as a result of organophospate and organochlorine poisoning. Myhill [2003] is also advising other prospective litigants on similar matters; all of which are sub-judice.

Additionally, Myhill [2003] stated that to her knowledge there were 400 other litigants waiting to sue the chemical companies for health damage. 'Globally, pesticides are known to kill 20,000-40,000 farmers each year, and the documented health effects of pesticide exposure include: leukaemia, brain tumours, prostrate cancer, sterility, birth defects, damage to the immune system and cognitive disorders such as impairment of memory and psychomotor speed, anxiety, irritability, and depression' [Solomon et al 2000]. Bremner [2002/2003], states that agricultural pesticides have been linked to infertility, suicidal depression and the most horrific birth defects imaginable. Bremner [2002/2003] also points out that '70% of farm workers in developing countries are children aged five to 15 years employed in a pesticide environment and that few survive beyond the age of 50 years after working to produce cash crops for our tables'. Their health situation suggests that research should be undertaken to establish what effect chemicals that have been and are in contact with consumers from residues in vegetable food crops they have produced and exported to the UK. A European Union Directive [European Community No 178/2002] lays down general principles and requirements of food law and contaminants in foodstuffs for England and Wales Statutory Instrument No 2591 [Her Majesty's Government 2003]. The stable level of pesticide residue in food permitted in Wales is shown in The Contaminants in Food (Wales) Regulations [2003]. Welsh Statutory Instrument No 1721 (W188) [Her Majesty's Government 2003]

2.4.2 Agri-chemical manufacture and distribution

The promotion of intensive agriculture to benefit profitability and, some say, quality of produce, has produced considerable income for the chemical industry. Acquisition of statistical data for chemical application to land and crops required extensive research. Figures released by The British Survey of Fertilizer Practice for the year 2000 are shown in Tables 2.2, 2.3, 2.4, and 2.5 It is stated that chemical application is recorded by distributors to be decreasing, but it has emerged that this lower application rate is of a significantly higher potency [Crop Protection Association 2001]. It is interesting to note that in 1999 British Agrichemicals Association changed its name to the Crop Protection Association [Crop Protection Association 2000], in that they would be projecting 'the image' that these products 'protect' crops, and do not harm them, or the people who work with them.

According to Helsel [1987] pesticides and fertilizers are manufactured in chemical plants with low labour input, remote from areas of usage and at great environmental cost. Furthermore, manufacture of synthetic pesticides and fertilizers involves a series of processes all of which consume energy equivalent to 80% of total production costs [British Survey of Fertilizer Practice 2000]. The majority of synthetic pesticides are manufactured from intermediates derived from ethylene, propylene or methane and these elements are transformed into the final products by a series of chemical reactions involving heating, distilling, filtering and drying which, combined with transportation, contributes to fossil fuel depletion and airborne pollution [Helsel 1987]. However the total number of people employed by pesticide manufacturing member companies of the Crop Protection Association within the UK in 2000 was published as 7,059 [Crop Protection Association 2001]. This includes 1,633 employed within distributor companies [Crop Protection Association 2001]. Selincourt [1997] observes the loss of employment resultant from the demise of UK pesticide manufacturing and distribution would be negligible and perhaps advantageous, initially, to the health of the redundant workers and, ultimately, to the whole environment.

Historical organic farm survey data indicates that overall labour requirements are typically 10-30% higher on organic farms than those on conventional farms [Lampkin 2001, 2002 and 2003]. The agricultural labour force in the UK farming operations during 1999 was published as 593,000 [National Statistics 2001]. It is a possibility therefore, that total organic agriculture could provide between 59,000 and 177,000 extra employment opportunities than the pesticide manufacturing and distributing sector, which would more than compensates for the loss of jobs in pesticide manufacturing and facilitate the reversal of rural de-population [Selincourt 1997].

According to Kongshaug [1998], the total energy consumption in worldwide fertilizer production is 4,400 million Gigajoules per year, which is equivalent to 1.2% of the global energy consumption. The majority of this global energy, (92.5%), is consumed by the production of Nitrogen based fertilizers; the production of Phosphate ($P2_20_5$) consumes 3% and Potassium (K_20) 4.5% [Kongshaug 1998]. The main greenhouse gases emitted as a result of the manufacture of fertilizers are Carbon Dioxide (CO_2) and Nitrous Oxide (N_2O) [Kongshaug 19981]. Nitrogen based fertilizers are used in the largest quantities to increase yields of cereal crops, main crop potatoes, oil seed rape and sugar beet [British Survey of Fertilizer Practice 2001]. Fertilizer manufacture generates the majority of the greenhouse gases from all chemicals used in food crop production [Kongshaug 1998]. Carbon Dioxide (CO_2) is the principal greenhouse gas, and concentrations in the atmosphere will continue to rise from the present 360 parts per million by volume to 450-600 parts per million by volume by the 2050s [Climate Change and Agriculture in the UK 2002]. The past decade (since 1991) in the UK has been the warmest in over 300 years, and 0.50 degrees centigrade warmer than the 1961-90 climate in the UK [Department for Environment Food and Rural Affairs (Climate Change and Agriculture in the UK) 2002]. Warm winters have reduced the number of frosts; warm summers have included record hot spells and high sunshine totals [Department for Environment Food and Rural Affairs (Climate Change and Agriculture in the UK) 2002]. However, Carbon Dioxide (CO_2) has actually been beneficial to food crop production in the UK by encouraging photosynthesis and reducing transpiration [Department for Environment Food and Rural Affairs (Climate Change and Agriculture in the UK) 2000]. It is possible that a reduction in fertilizer and pesticide manufacture would decrease the overall detrimental global warming effects of greenhouse gas (including flooding/salt water incursion) [Rosenzweig and Hillel 1995]. Conversely, reduction in the use of fertilizer may become less beneficial to agriculture by lengthening the growing season and inflicting plant stress [Rosenzweig and Hillel 1995]. Higher temperatures possibly generated by the greenhouse effect will also warm the soil, thus speeding the natural decomposition of organic matter and increase the rates of other soil processes that affect plant fertility [Rosenzweig and Hillel 1995]. Warmer conditions are more favourable for the proliferation of insect pests; longer growing seasons will enable some insects to complete a greater number of reproductive cycles during spring, summer and autumn and warm winters will allow larvae to over-winter in areas where they are now limited by cold weather [Rozenzweig and Hillel 1995]. Additional application of fertilizers and pesticides to counteract these variables will exacerbate environmental risk to animal and human health [Rozenzweig and Hillel 1995].

Artificial fertilizers and the raw materials required for their production are the fourth largest bulk commodity in world shipping after iron ore, coal and grains [Isherwood 2000]. After manufacture, fertilizers are packed into suitable containers, transported to distributors and then to farms for application to crops. In the UK, 80% of all fertilizers are delivered in 500 kilogram bulk containers, with the rest delivered in non-biodegradable 50 kilogram bags [Isherwood 2000]. All fertilizers traded in the UK are transported by road, contributing further pollution to that generated by the movement of pesticides [Isherwood 2000].

2.4.3 Costs of chemical application to land

Financial aspects of agriculture appear to be of little concern to consumers who unknowingly contribute to the considerable external costs of intensive food production through taxes to clear up pollution in the environment. They, the consumers, have also provided subsidies to create pollution through the agri-chemical applications described above. Awareness through education is fundamental for environmental sustainability. Chemical application to land and crops has manifested itself in harmful ways as described above.

Biotechnology companies advise that genetic modification will achieve demands for food crops at affordable prices and solve farmers' problems, but a director of Novartis, the worlds biggest bio-technology seed company [Smith 2000] has categorically stated that "if anyone tells you that Genetic Modification is going to feed the world, tell them that it is not; to feed the world takes political and financial will - it's not about production and distribution". "Be aware that genetically modified crops are resistant to herbicides and pesticides and it follows that extra applications of chemicals to control weed or pest will ensue to enhance productivity" [Smith 2000]. This application may not be taken up by plants but will manifest in the soil and watercourses as described in sections 2.2 and 2.12. A recent report from Benbrook [2003] concludes that the 550 million acres of Genetically Modified corn, soybeans and cotton planted in the United States of America since 1996 has increased pesticide use (herbicides and insecticides) by about 50 million pounds weight of chemicals.

Perhaps the most worrying aspect of chemical application to land to promote rapid vegetable crop growth is the risk to human and animal health. If the application of chemical substances to vegetable food crops as discussed by Benbrook [2003] manifests in human diseases, the inevitable extra costs in health care should be considered an external cost incurred by farming practice.

2.4.4 Residual leachate from farm chemical application

Section 2.4 and 2.4.1 2.4.2 and 2.4.3 above dealt with chemical application to land, soil degradation and a range of human health issues, but there is no mention of the external costs in monetary terms and to clean up natural capital alone, as detailed below, would cost £2.3 billion [Pretty et al 2000]. But, this significant funding to the UK national economy is only possible with annual support policies [Pretty et al 2000]. The Department for Environment Food and Rural Affairs administers support policies agreed in Brussels, which provide, annually, around £3 billion to UK agriculture from the European Union budget [Pretty 2000]. In addition, some £800 million is given in direct domestic support [National Statistics 2001]. The residue from the application of chemical fertilizers and pesticides to land is leached into streams, lakes, rivers and aquifers to the detriment of diverse ecosystems and human and animal health [Brenman 1999]. It is illustrated in Table 2.6 that clearing pesticides from drinking water costs £120 million and the removal of Nitrogen costs £16 million annually in the UK [Pretty et al 2000]. The removal of leached Phosphate ($P2_20_5$) integrated with soil incurs a cost of £55 million annually; indeed, in 1996 it was estimated that a total of £2,343 million was spent annually to remove leached agri-chemicals in the UK [Pretty et al 2000]. Pretty et al [2000] calculate that the external cost for cleaning up damage from agri-chemicals equates to £208 per hectare of arable and permanent pasture land. The author has not been able to locate later objective research relevant to external costs. However, Pretty et al [2000] points out that in 1988 The Office of Water Services (now Water Voice Wales and OFWAT) estimated that water companies would spend a further £600 million on capital expenditure due to continuing deterioration of 'raw water' between the years 2000 and 2005. The same returns estimate that the expenditure for pesticide removal from water will fall to £88 million and for nitrate to £8.3 million per year at the end of the 1990's and early 2000's [Pretty et al 2000].

Table 2.6. Annual total external costs of UK agriculture, 1996 (range values for 1990–1996)

Cost category	UK (£million)	Range[b] (£million)
1. *Damage to natural capital — water*		
1a. Pesticides in sources of drinking water	120	84–129
1b. Nitrate in sources of drinking water	16	8–33
1c. Phosphate and soil in sources of drinking water	55	22–90
1d. Zoonoses (esp. *Cryptosporidium*) in sources of drinking water	23	15–30
1e. Eutrophication and pollution incidents (fertilisers, animal wastes, sheep dips)	6	4–7
1f. Monitoring and advice on pesticides and nutrients	11	8 11
2. *Damage to natural capital — air*		
2a. Emissions of methane	280	248–376
2b. Emissions of ammonia	48	23 72
2c. Emissions of nitrous oxide	738	418–1700
2d. Emissions of carbon dioxide	47	35–85
3. *Damage to natural capital — soil*		
3a. Off-site damage caused by erosion[c]	14	8–30
3b. Organic matter and carbon dioxide losses from soils	82	59–140
4. *Damage to natural capital — biodiversity and landscape*		
4a. Biodiversity/wildlife losses (habitats and species)	25	10–35
4b. Hedgerows and drystone walls	99	73–122
4c. Bee colony losses	2	1–2
4d. Agricultural biodiversity	+[d]	+
5. *Damage to human health pesticides*		
5a. Acute effects	1	0.4–1 6
5b. Chronic effects	+	+
6. *Damage to human health — nitrate*	0	0
7. *Damage to human health: microorganisms and other disease agents*		
7a. Bacterial and viral outbreaks in food	169	100–243
7b. Antibiotic resistance	+	+
7c. BSE[e] and nvCJD	607	33–800
Total	2343	1149–3907 [a]

This table does not include private costs borne by farmers themselves.

[b] The ranges for costs do not represent formal standard deviations of the data as this is impossible given the huge variation in types of data and contexts. The ranges represent best estimates for higher and lower quartiles for costs incurred annually during the 1990s. The range values for the external costs in category 2 are calculated from the ranges stated in studies of external costs of each of these gases, rather than the variation of emissions during the 1990s.

[c] The offsite damage caused by erosion in category 3a does not include the costs of removing soils/sediments from drinking water (these are in cost category 1c).

[d] +, Not yet able to calculate costs.

[e] BSE costs are an average for 1996 and 1997.

Source Elsevier Science [2000]

2. 5 Farm income

Knowledge of farming problems and details of agricultural/horticultural profitability could provide increasing awareness of the effects of food importation and the domination by large food groups over price and marketing structures within that industry. The consumer should be more aware of the income levels and security of vegetable food crop producers. The purpose of this thesis is to establish benchmarks for economically viable vegetable food crop production on a particularly local basis within sustainable parameters. Localisation has been shown to affect the Ecological Footprint by reducing pollution levels from transportation. Furthermore, agri-chemical manufacture, distribution and use for intensive vegetable food crop production affects human and animal health, soil fertility and water supplies. The affects of the Common Agricultural Policy and the "globalising" trend for supermarkets and food manufacturers to source the cheapest food possible from around the world argues Friends of the Earth [2002], has contributed to the reduction of farm incomes within the UK. Since 2002, farm incomes have been at an all time low because of the strength of the UK pound against the United States of America Dollar and the European Union Euro [Friends of the Earth 2002]. Many sectors are close to or below the cost of production yet supermarket profits continue to soar and the large retailers and food manufacturers expand their control and influence [Friends of the Earth 2002].

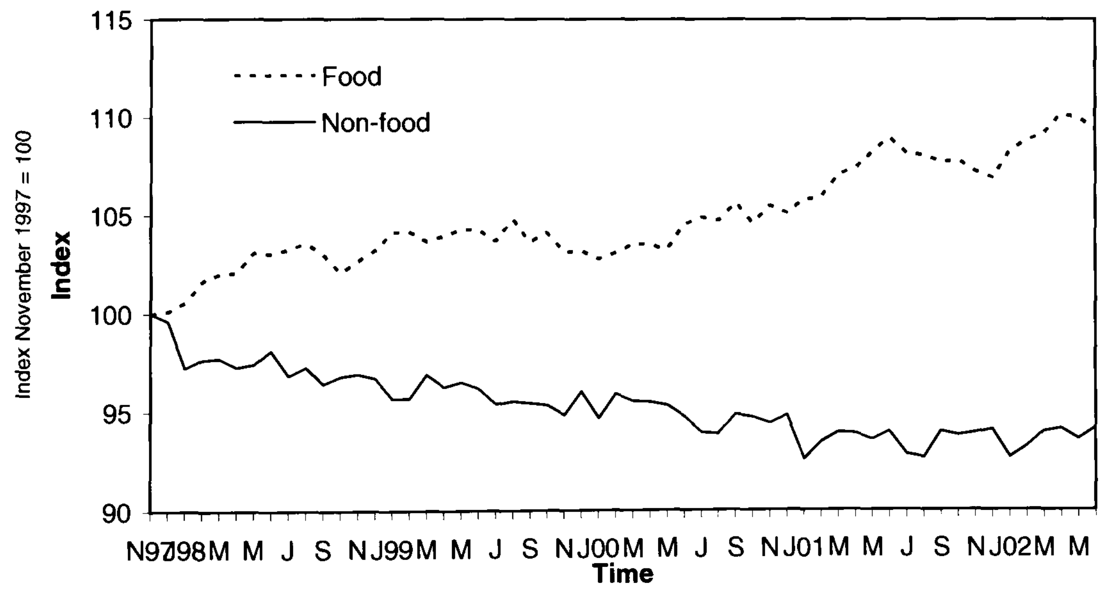
In 2001 the total income from farming in the UK was estimated to be £1.7 billion. This estimate was 13% higher than the 2000 level, which was based on 1995 levels, which was the starting point for analysis of the 2002 situation [National Farmers Union

(Organic Members Survey) 2002]. However, when comparing this previous figure with 1995 total income from farming levels, an overall decrease of 71% is evident, according to the National Farmers Union Review [National Farmers Union Farming in Crisis 2002]. This latter document attributes financial problems within the farming industry to the 2001 foot and mouth epidemic, and a strong pound sterling, for this dramatic fall of 71% in farming income. The total income from farming figure represents business profits and income to farmers, partners, directors and those with an entrepreneurial interest in the business [National Farmers Union 2002].

In 1995 total income from farming reached its lowest point since the depression of the late 1930s, even though it had doubled in real terms between 1990 and 1995 [National Farmers Union 2002]. Fluctuating considerably, total income from farming exhibited a general decline between 1973 and 1990, followed by a sharp rise in 1995, attributable to a decreasing share of the final value of their produce for farmers across the farming industry [National Farmers Union 2002]. According to the National Farmers Union [2002] many farmers are unable even to recoup their production costs, and in November 2003 the National Farmers Union reported an increase in total income from farming for the year 2003, up 35% in real terms since the 2002 figure but notes that it is still some 50% below the 1995 figure [National Farmers Union 2003]. The main purpose of benchmarks is to improve and sustain the economic viability and stability of small and large vegetable food crop producers and maintain environmental sustainability at the same time.

The rate of inflation in the retail price of food, compared to the rate of growth in farm prices, highlights the decreasing share in the value of produce for farmers [National Farmers Union 2002]. From November 1997 to June 2002, inflation in food prices was 1.7% per year on average, well below the retail price index average of 2.3% and the reason for the contrast was that non-food prices had fallen by 1.1% a year since 1997 on average [British Retail Consortium 2002]. Figure 2.1 below shows the breakdown between food and non-food price inflation in 2002 [British Retail Consortium 2002]. Local fluctuations in supply and demand, weather conditions and world commodity prices, shifting exchange rates, since 1990 have all been major contributory factors to decreases in total income from farming [National Farmers Union 2002].

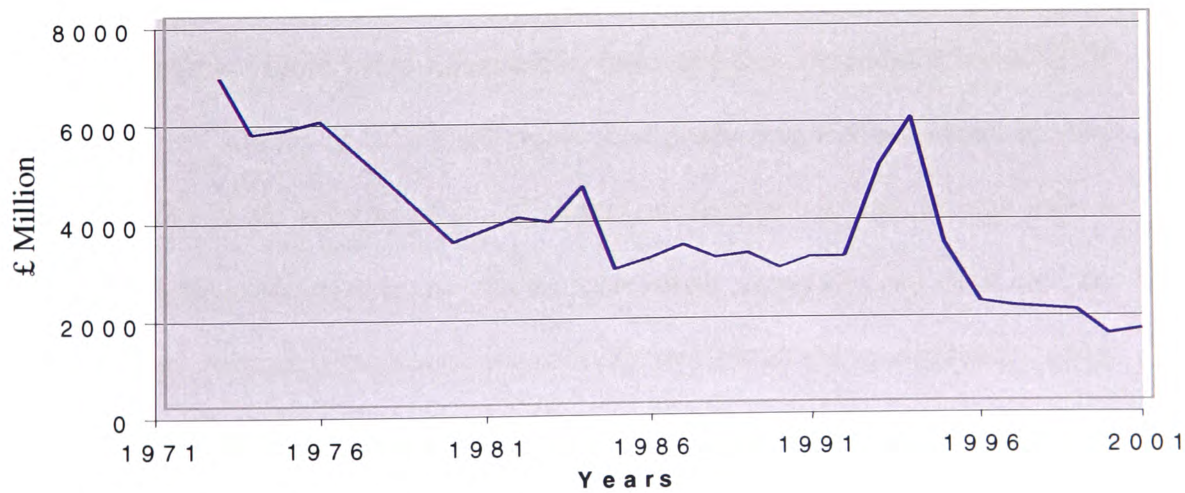
Figure 2.1 British Retail Consortium: food and non-food split [2002]



NB ***Numbers and letters re-produced on the Y axis from left to right labelled 'Time' indicate November 1997 to January 1998; M=March and May; J=June; S=September; N=November; J 99=January 1999 and the same sequence continues to January 2002 and March and May 2002 to represent the difference between inflation of prices within the retail price index comparing food and non-food items.***

Farmers are concerned that they should raise production to higher levels to facilitate the reduction of food crop prices in the belief that economies of scale will resuscitate their industry [National Farmers Union (Farming in Crisis-Total Income from Farming) 2002]. Their main problems could be attributed to supermarket domination of farm gate prices and cheap imports produced in overseas climates with the benefit of cheap labor, retailed at competitive prices below those required by UK producers even with the benefit of subsidy. A better understanding of benchmarking for cultivation of vegetable food crops on a local basis could raise production of vegetable food crops for sale at a local level to realise increased economic gain and at the same time minimize distribution costs. Figure 2.2 below illustrates the trends in UK farm incomes between 1971 and 2001. The Deloitte and Touche Food and Agricultural Group survey of farm incomes [2002], now in its 12th year, illustrates a small increase in farm profits between 2001 and 2002.

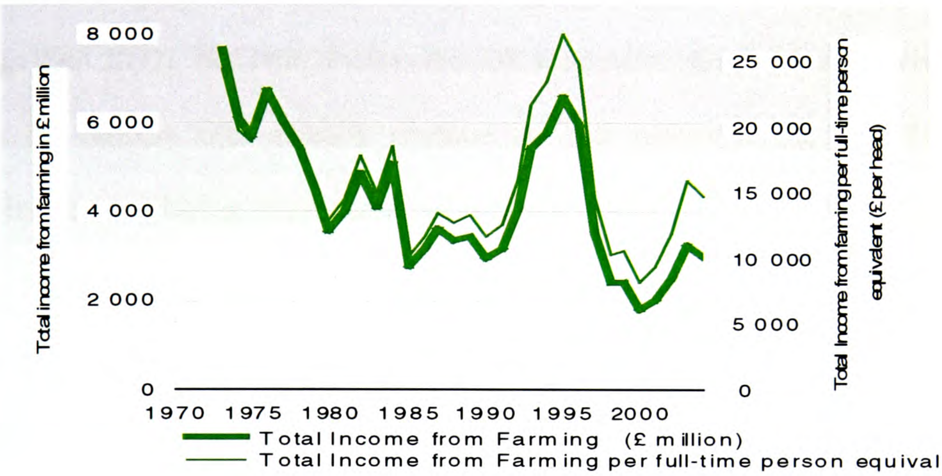
Figure 2.2 British Retail Consortium Trends in UK farm incomes between 1971 and 2001. Source British Retail Consortium



Deloitte and Touche Food and Agricultural Group estimate lowland farm client income has risen from £5.00 to £18.00 per acre (0.4047 hectares) which does not herald a recovery of farming fortunes compared with previous years. Deloitte and Touche Food and Agricultural Group annual audits [Deloitte 2002] forecasts a decline in National Farm Income to £12.00 per acre (0.4047 hectares) in 2003 from a maximum of £18.00 in 2002. Only 50% of farm output in the financial farming year from June 2001 to June 2002 was generated from food crop production, compared to 70% in 1996/1997 when food crops were responsible for most of farming profits. The Deloitte and Touche Food and Agricultural Group [2002] survey was prepared from the aggregated accounts of farming clients from July 1996 to the year ending June 2002, which highlighted that the majority of farmers earned a negative income from food crop production which, as mentioned above, represents 50% of net total productivity. Hill [2004] in a Deloitte and Touche Food and Agricultural Group press release, states that in 2004 farm incomes soared from £43 per hectare to £200 per hectare but the boost will be short lived. "we estimate that the average net farm income will fall away to just £83 per hectare in 2005" [Hill 2004]. Hill [2004] also argues that "in short, incentives to Britain's farmers will subtly change from food production to countryside stewardship". "A picture is emerging of Britain's farms being supported by three different sources of revenue" [Hill 2004]. "First the fortunes of traditional arable food production will be subject to very large swings due to the vagaries of global market and weather, second, income from a range of diversification investments will be increasingly important and third, will be income derived from agri-environmental activity and landscape management" [Hill 2004]. These predictions lead the author to believe that the UK will become even more dependent on imports of vegetable food crops and therefore an increasing need for profitable efficient and sustainable local vegetable food crop production is evident.

Figure 2.3, sourced from the Department for Environment Food and Rural Affairs 2004, illustrates their record of farm income trends.

Figure 2.3 Farm Income Trends 1970-2004



[Source Department for Environment Food and Rural Affairs 2004]

The minimum wage of farm workers increased by 4.4% in the financial year 2001 to 2002 resulting in a fall of 3.6% in actual labour costs to farm employers [Deloitte and Touche Food and Agricultural Group 2002]. The Royal Agricultural Society of England [2001] revealed that farmers were working between 70 to 90 hours per week, for as little as £4.70 per hour, to compensate for the loss of farm labour. By comparison the supermarket groups continue to prosper from supplies discussed in Figure 2.1 above. Tesco's annual earnings, as an example, were a revelation with declared profits of £1 billion for 2001 to 2002. For 2003 to 2004 profits were £1.5 billion and in 2004-2005 £2.03 billion [BBC 2005]. Localisation of vegetable food crop cultivation and distribution could provide the farmer and some 60 million consumers with considerable cash benefit from a share in this £2.03 billion. If Tesco's hourly profit from their 768 stores (2001 to 2002, and 906 stores during 2003 to 2004), each open for a total of 90 hours per week during 2001 to 2002, was equivalent to that of farmers at £4.70 per hour for a 52 week year, Tesco's annual profit would total slightly less than £17 million. Over the same year 768 farmers earned slightly less than £325,000 in total between them [Hill 2002]. Hill [2002] states that UK food production has to be underpinned; not just for farmers who actually produce the raw materials, but also for the many businesses employing large numbers of people further along the food chain. When it first began moving into Malaysia in 2002, Tesco was anxious to make assurances that it would 'work closely with local suppliers to source many own-label products locally' – 'however, the same article states that these products will eventually be exported to Tesco stores in other countries, so it does not really come into the category of local scale production' [Corporate Watch 2005]. 'It is very hard to imagine how such a large company, with such an emphasis on hypermarkets in so many parts of the world, can ever realistically say it is going to source products for its stores locally' [Hill 2002]. Hill [2002] believes that Her Majesty's Government can assist farm food crop production by supporting and providing the necessary incentives to encourage farmers and food processors to pool their resources and encourage large scale heavily capitalised organisational methods. Hill [2002] also states that this latter strategy should buffer seasonal swings in commodity prices, and develop well managed cost competitive and market led processes beyond the farm-gate. Furthermore, Hill [2002] advises that this process should be supported by increased funding from Her Majesty's Government Treasury. This, states Hill [2002] should be for modulation, through land management contract systems to promote environmental protection and buying and selling through co-operative systems, which will provide farmers with a greater stake in processing and marketing their produce [Countryside Alliance 2001]. The Countryside Alliance [2001] advises that such a scheme would provide farmers with retention of a larger share of the profits from their produce. The author believes that co-operative systems of distribution could also involve community vegetable food crop production. The profits of supermarket groups continue to increase with increasing food sales and price rises in their stores as shown in Figure 2.1, seemingly at the expense of farmers whose incomes decreased as shown Figures 2.2 and 2.3. As stated above, the rate of food price inflation (1.7 % yearly average) is lower than non-food items but nevertheless there does not appear to be a benefit to farmers or consumers.

CHAPTER 3

ORGANIC PRODUCTION IN THE LATE 20^{th} CENTURY

Chapter 3: Organic production in the late 20^{th} Century

3. 1 Introduction

Previous chapters introduced global environmental issues and elements of food production, especially for vegetable food crops within the UK. Chapter 1 discussed the creation of benchmarks for vegetable food crop production to provide financial efficiency and sustainability through localisation as the study purpose. The aims and objectives of the thesis were described. The Ecological Footprint was defined and reviewed as a concept connected to vegetable food crops benchmarks and sustainability. Social cohesion within localized economies and communal vegetable food crop production were outlined. Land use, agriculture and food transportation effects on the ecological footprint, especially in Wales, was described. Misuse of land, damage to natural capital due to pesticide and fertilizer use in agriculture, disposal of waste vegetable food crops from supermarkets and residual toxic chemicals in food were considered unnecessary and unsustainable. The author championed the localisation theory of community based small scale organic vegetable food crop production on vacant allotment and other vacant land spaces. Benchmarking could facilitate ease of organic vegetable food crops production to stimulate local enterprise and contribute to a more sustainable and socially cohesive society. In chapter 2 increasing demand for vegetable food crops and the import and export of fresh produce were considered. Vegetable food crop cultivation involving intensive growing and the integrated method were considered. Because the original intention was to construct benchmarks for vegetable food crops production solely upon organic growing. Chapter 3 will verify the increasing demand for organic produce. As will be seen in chapter 5, difficulty arose when the author requested the participation of registered organic producers in the study. Some organic growers cooperated but others in the sample whose input and input variables were recorded were conventional producers or were using mixed cultivation methods. Because organic registered growers participated in the survey, the history of the Soil Association rather than of intensive growing enterprises is discussed. It is hoped that the benchmarks developed from this study will be used in an organic context to further sustainability, through natural growing methods, within smaller localized production areas.

3.2. Organic food production - a brief history

A recent case study, 'Retailing Organic foods' [Jones et al 2001] examines the reasons for the dramatic consumer demand for, and the marketing, of organic food, specifically in the retail sector. The study firstly recognises the term 'organic food' as a concept identified in the 1940s, although the underlying concept is much older, as described later in this chapter. Jones et al [2001] are cognisant that, prior to the 1940s, all farming practice within the UK was on an organic basis. "Generally, the term 'organic' is seen to refer to food raised, grown or stored and/or processed without the use of synthetically produced chemicals or fertilizers, herbicides, pesticides, fungicides, growth hormones and regulators or genetic modification" is their preferred definition. However, Jones et al [2001] opine that "providing precise and universally agreed definitions of organic farming and organic food is not a straightforward task". As a supporter of organic methods, the author realises that to practice pure organic agriculture would require the complete banning of all agri-chemicals within the UK, which would contribute to sustainability in many aspects concurring with the primary aims of the Soil Association which are:-

- Healthy soil.
- Healthy food.
- Healthy people.

It is known that wind, rain, birds and other animals spread pesticides and fertilizers (the same criteria applies to the spreading of plant diseases) over wide areas including land under organic cultivation. The reader will recall details of chemical use on land and crops and the resultant ecological damage caused, described in chapter 2 section 4.

The organic movement in the UK has a long history. Sir Albert Howard undertook his seminal work on composts in India in the 1920s and the oldest organic farms originate from the 1930s, when other countries around the world were just starting to follow the chemical alternative [Soil Association and European Commission (Ecological Footprint Report) 2002]. A few Utopians, considered in the 1930's and 1940's to be an eccentric minority, were proponents of 'back-to-the-land philosophy' [Soil Association and European Commission (Ecological Footprint Report) 2002]. According to Reed [2003] the founding meeting of the Soil Association was held on 12^{th} June 1945 and was attended by a selection of one hundred people from diverse organizations such as the Kinship in Husbandry, writers, farmers and political activists]. Scientists and nutritionists concerned by the health implications of increasing intensive agriculture practices also attended [Fox 2005 and Dudley, and Woodward 1997]. Organic farming gained coherence with the publication of a book by Balfour [1943] "The Living Soil" and the establishment in the same year of the Soil Association membership charity [Fox 2005]. However, early pioneers possessed only a fairly tenuous link with the modern world of organic agriculture; in their era no organic food premium, standards, or regulations were in existence alongside a far broader interest in "whole food" than is apparent today. Organic farming in the UK was mainly directed towards proving the theories expounded in Balfour's book 'The Living Soil' [Dudley and Woodward 1997]. In 1954, Hills founded The Henry Doubleday Research Association for gardeners, which has established a National Centre at Ryton Gardens in Warwickshire UK [Henry Doubleday Research Association 2004]. Henry Doubleday Research Association claims to be the largest organic membership organization in Europe [Henry Doubleday Research Association 2004].

During 1967 the first set of organic guideline standards were published by the Soil Association and the Soil Association Organic Marketing Company, now superseded by Soil Association Certification Ltd, a company set up in 1973 to inspect and certify organic food [Fox 2005]. The Pye Research Centre, a Charitable Trust connected to the Soil Association, was established during 1971 in Suffolk UK and undertook a series of long term organic production research as a continuum of organic growing trials started by the Haughley Research Trust in 1940 [Fox 2005]. Haughley Research Trust failed due to inadequate funding in 1946 and Pye Research Centre folded in 1987 for the same reason [Fox 2005]. One of the most respected independent organic research institutes in the UK is Elm Farm Research Centre founded in 1980 and based on a working organic farm in Berkshire [Elm Farm Research Institute 2004].

In 1983 the British Organic Standards Committee was established by British Organic Farmers and the Organic Growers Association. These organizations together with the Soil Association, all representing different aspects of the nascent organic industry, gained control of organic registration [Reed 2003]. The British Organic Standards Committee was later superseded by the UK Government led United Kingdom Register of Organic Farmers and Growers now responsible for implementing the European Council Regulation (Ecological Footprint) 2092/91 on organic produce in the UK [United Kingdom Register of Organic Farmers and Growers 2001].

3.2.1 The demand for organic food

Six decades from the formation of the Soil Association in 1946, 'you could go all over the world at the moment and you will find concern about the intensification of agriculture, the effect on food safety and food quality, the effect on biodiversity, the effect on the environment' [Holden 2003]. 'A key factor for growing organic sales is the continuing flow of organic products into mainstream distribution, ensuring wider availability' [Holden 2003]. 'With growth rates currently at a faster pace than the conventional food market, new organic product launches are likely to remain a feature of the market' [Mintel 2003]. An awareness of the implications of conventional food consumption and the benefits of eating organic produce is now more in the public domain [Coghlan et al 2002].

Bordeleau et al [2002] state that 'in the UK the increasing demand for organic produce is strongly linked with freedom from chemical residues and personal health rather than environmental issues', 'which relates to food quality because less chemical residues on food will increase food quality' [Coghlan et al 2002]. However between 2000 and 2001 the sale of organic produce in Europe increased by 50%, with the UK having the fastest growing organic market within Europe for 2001, accounting for 1% of the total value of food and drink consumed in the UK [Coghlan et al 2002].

Of major concern is that only 25% of organic produce bought in the UK is grown within the country itself [Coghlan et al 2002]. It could be said that the pollution caused by transporting 75% of Britain's organic produce requirements from global destinations to the UK out-weighs any environmental advantages gained by choosing organic produce [Pretty 2002].

As discussed in chapter 2 there is a definite need to reduce the CO_2 emissions associated with intensive agricultural production in the UK [Isherwood 2000]. Mintel [2001] states that since 1999 the sales of organic products in the UK have shown an increase partly due to the expanding product range availability. However, the share taken by fruit and vegetable food crops has fallen since 1999 due to the enlarged number of organic products competing for a share of consumer spend Mintel [2001]. Organic food production has not grown at the rate of demand for those goods within the UK and the organic growing industry remains a minor sector of total agricultural production within the UK [Mintel 2001 and Soil Association 2002]. Mintel [2001] and Soil Association [2002] believe that the demand for organic produce is market-led and could be satisfied were more financial support for land conversion to organic standards to become available within the UK. In 2003, the Department for Environment Food and Rural Affairs introduced a new scheme which aims to alleviate problems within the previous scheme, under which no ongoing funding provision was made for organic conversion [Department for Environment Food and Rural Affairs 2002].

The previous Organic Farming Scheme did not take account of growers' lack of income during the period of conversion to organic status [Department for Environment Food and Rural Affairs 2002]. The 2003 Organic Farming Scheme will provide ongoing subsidies over five-year periods having, £22 million available in the first year and £23 million for each of the following years until 2007 [Department for Environment Food and Rural Affairs 2002]. Mintel [2001] notes that The Soil Association and other organic trade sources have estimated that 75% of organic food consumed in the UK is imported, of which 85% is organic fruit and vegetables. Much is sourced from Canada, the United States, the Caribbean, South America, Asia, Australia and North Africa [Mintel 2001]. Table 3.1 defines cash turnover and percentage increase of sales within the UK for organic fruit and vegetables during the period 1999 to 2001 [Mintel 2001]. Therefore, imports account for approximately £345.1 million of total organic fruit and vegetable sales within the UK during that period [Mintel 2001].

Table 3.1 Retail sales of Organic fruit and vegetable 1999 and 2001

	1999		**2001 estimated**		**% point**	**% point**
	£m	**%**	**£m**	**%**	**change**	**change**
					1999-2001	**1999-2001**
Fruit & vegetables	**303**	**5 5**	**406**	**41**	**-14**	**+34.0**

Source Mintel 2001]

According to Mintel [2001] the UK supermarkets are responsible for 76% of total organic food retailing sales and are increasing their market share. Large manufacturers, including Unilever, Nestle and Rank Hovis Macdougall, are entering the organic food sector by purchasing existing organic brand names and developing new ranges under those brand names [Mintel 2001]. Lucas [2001] extrapolates and discusses statistics relevant to the import and export of food and associated products for the UK. The Green Party European Free Alliance Report, calls for more organic production, less intensive agriculture and the prioritising of local food production and consumption. Perhaps, suggests Lucas [2001], a useful way to envisage this new approach is to think of it in terms of 'foodsheds' – a term coined by American rural sociologist Jack Kloppenberg Pretty [2001], which combines local and regionalized food systems with environmentally-sensitive farming. Kloppenberg, defines 'foodsheds' as "self-reliant, locally or regionally based food systems comprised of diversified farms using sustainable practices to supply fresher, more nutritious foodstuffs to small-scale processors and consumers to whom producers are linked by the bonds of community as well as economy" Lucas [2001].

3.2.2 Meeting the demand for organic food

Ostensibly, consumers have accepted the advertising 'hype' disseminated by national and global companies implying that intensively produced food is cheap and nutritious, unaware of residual agri-chemicals present in food or damage to ecological systems from their application during crop production [Coghlan et al 2002]. However, the demand for organic produce is increasing, as shown in section 2.1 not withstanding the anti-organic myth. A Report 'Expose in Europe of the Anti-Organic Myth' [Fookes

[2002] compiled for the Organic Consumers Association identifies national and global companies, free market think-tanks, academic institutions and non-organic farming associations as staunch opponents of organic produce. These organizations include The Hudson Institute, The Soil Association, a free market pro-globalisation think-tank comprised of and funded by the large bio-technology companies Monsanto, Agrevo Canada, Novartis Crop Protection, Zeneca Agrochemicals, the Global Crop Protection Federation, Pfizer, and Union Carbide [Fookes 2002]. The Institute for Economic Affairs UK, The Scottish Crop Research Institute and the National Office of Animal Health UK are also cited by Fookes [2002]. These bodies are allegedly perpetrating unsubstantiated myths through the issuing of misleading and erroneous statements to the press including, as follows:-

- Organic foods are no healthier than non-organic foods.
- Organic farming increases the risk of food poisoning.
- Organic farming uses pesticides that damage the environment.
- Consumers are paying too much for organic food.
- Organic food cannot feed a hungry world.
- Organic farming is unkind to animals.

Expose in Europe of the Anti-Organic Myth [Fookes 2002] has been published by The Soil Association and Sustain (Sustain is the Alliance for Better Food and Farming) and is endorsed by thirty-six public interest groups from the National Federation of Women's Institutes to World Wildlife Fund-UK. Factual and well researched robust information within the report refutes every allegation and claims to prove the veracity of organic principles in all respects [Fookes 2002].

One proposed solution in order to meet UK and European needs for organic produce, and at the same time promote the use of sustainable organic principles and methodologies, would be to promote local community-level based food crop production. Indeed, there are many advantages to community food crop production, including reduction of waste through recycling and composting, reduction in traffic with its associated pollution, preservation of soils, efficient use of irrigated water and the provision of employment [Littlewood et al 2002]. 'The range of economic benefits claimed for local production includes employment creation, business survival, support for local services and suppliers and increased retention of income within the local community' [Jones et al 2004]. 'Perhaps an immediate solution would be to adopt large-scale production of organic food crops in the UK and Europe' [Littlewood et al 2002]. Logistically this would prove impractical, as land rotation which alternates soil-building crops one year, such as pasture grasses, with food crops the next, would be a prerequisite [Coghlan et al 2002]. To meet current food crop production levels by organic means would require twice the area of land used by non-organic methods, with a catastrophic loss of natural habitats [Coghlan et al 2002]. Equally, there would be significant problems of environmental pollution, such as those caused by transporting food crops to consumers, and the potential contamination of water caused by excess Nitrogen run-off from organic manure. [Coghlan et al 2002]. In addition, there is the problem of soil erosion, described in chapter 2 section 4, which could ultimately be remedied using organic cultivation methods

3.2.3 Overview - organic conversion - producers Registration Bodies and Standard

There are nine organic registration bodies and one non-organic registration company which advocates organic methodology on a pledge basis. All are described in Appendix 1.

The author's definitive overview of organic conversion, for food production, preparation and distribution methods identifies the rigidity of the rules and regulations applicable within the UK and the European Union under Council Regulation (Ecological Footprint) 2092/91, overseen by those registration bodies.

There is a United Kingdom Register of Organic Farmers and Growers approved list of organizations under European Union Regulation 2092/91 whose certifying arrangements comply with European Norm (EN) 45011 (Appendix 1), which sets out organic and other standards [Department for Environment Food and Rural Affairs 2002]. The list includes certification bodies in Ireland to facilitate the importation of Irish produce into the UK.

United Kingdom Register of Organic Farmers and Growers Standards for organic food production are the minimum applicable in the UK and are based on the amended 1993 European Council (Ecological Footprint) Regulation 2092/91, which sets out the inputs and practices permissible in organic farming and growing and the requisite inspection system. Regulation also applies to processing, processing aids and ingredients in organic foods [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) 2002]. Categorised on the basis of principles relevant to organic production at farm level, United Kingdom Register of Organic Farmers and Growers Standards require a mandatory period of conversion before planting of at least two years in some instances and three years in others [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) [2001]. The United Kingdom Register of Organic Farmers and Growers Standards are determined by set procedures. For example, there must be degradation, to an insignificant level, of any plant protection product which has been used before conversion procedure commencement within the soil and on any perennial crop grown in situ [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) 2002]. The United Kingdom Register of Organic Farmers and Growers Standards are rigid; for example the fertility and biological activity of the soil must be maintained or increased initially by cultivation of legumes, green manure application or deep-rooted plants in an appropriate multi-annual rotation program [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) 2001 and European Directive 91/676/ (Ecological Footprint)]. Manure from organic livestock production may be applied, as can other organic material, composted or not, from holdings employing organic methods and registered as such [Department for Environment Food and Rural Affairs United Kingdom (Register of Organic Farmers and Growers) 2001 and European Directive 91/676/ (Ecological Footprint]. The total amount of manure applied on any holding, as defined in Directive 91/676/ (Ecological footprint), may not exceed 170 kilograms of nitrogen per year per hectare in order that the stocking density may be controlled [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) 2001 and European Directive 91/676/ (Ecological Footprint]. The same measure of nitrogen applies to utilisation of organic animal manure on other agricultural holdings and the total content includes other nitrogenous applications [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) 2001]. Should these fertilization methods be deemed inadequate, the use of other organic or mineral fertilizers, such as rock phosphate or lime, may be allowed, provided that strict stipulations are observed [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) 2002]. All production standards within the register are similarly strictly defined. Department for Environment Food and Rural Affairs (the United Kingdom Register of Organic Farmers and Growers Standards [2002] recommends methods for the control of pests, diseases, and weeds. Choice of appropriate species and varieties, rotation programmes, mechanical cultivation procedures, protection of natural pest predators through the provision of favourable habitats (hedges, nesting sites, release of predators) and flame weeding constitute practical options. Advice concerning recourse to alternative control methods if crops are under immediate threat is provided in chapter 11 B of the same Standards; similarly, Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) [2002] exist for organic livestock production. Organic animal husbandry is often inextricably linked to food crop production by the use of animal manure for organic growing and where grazing animals are turned out onto organic land lying fallow or under conversion. To ensure organic purity in food crops, any fertilizer derived from livestock and used for food production must be from animals reared under an approved organic scheme. Manure from intensively reared cattle, pigs and poultry contains the residue of growth hormones and anti-biotics which, if applied to organic soil, will be taken up by produce grown there. It is imperative that closed flocks are fed 90% organic rations (80% for poultry and pigs), with sheep and cattle receiving at least 60% organic dry matter from fresh or conserved forage [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) 2002]. This is to prevent ingestion of chemical substances added to animal feed products. Animals slaughtered and sold as organic meat are required to have been born and raised on a registered organic holding [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) 2002]. Animal health is fundamental to the organic livestock system; routine use of antibiotics, wormers and vaccines is prohibited [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) 2002]. However, to prevent long illness or suffering, some conventional medicines may be used, with organic standards necessitating long withdrawal periods; the use of homeopathy is encouraged [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers Standards) 2002]. Department for Environment Food and Rural Affairs The United Kingdom Register of Organic Farmers and Growers Standards [2002] for animal husbandry define requisite grazing parameters for each animal and the separation of species within buildings and grazing areas, and grazing on common land is permitted subject to specific conditions. All animals must have access to pasturage or open-air exercise [Department for Environment Food and Rural Affairs (United Kingdom Register of Organic Farmers and Growers) [2002]. Application of the organic rules above would be difficult to enforce upon small community groups, including schools, participating in vegetable food crops production on a localised basis, as theorised within this thesis. Soil and crop testing requires laboratory facilities and growing areas need regular monitoring for which commercial growers contribute funds to the licensed organic registration bodies under the United Kingdom Register of

Organic Farmers and Growers scheme. However, membership of the Wholesome Food Association offers an alternative [Wholesome Food Association 2002] (See Appendix 1).

3.2.4 Organic production

During 2001, the UK had the fastest growing organic market in Europe, showing an increment of 33% from £605 million in 2000 to £805 million in 2001; sales accounted for one per cent of the total value of food and drink in the UK [Soil Association 2001]. A 15% increase to £920 million occurred between April 2001 and April 2002, but 65% of the sales were of imported organic food [Soil Association 2002]. During the same period, the area of fully organic farmland in the UK almost doubled [Soil Association 2002]. During the 2000 and 2001 period, UK organically produced vegetables were valued at £26.62 million and, in the 2001 to 2002 period, at £36.85 million [Soil Association 2002]. However, the results of a survey by the National Farmers Union, mailed to 2000 of its organic members, reveal a struggling industry [National Farmers Union 2002]. The number of organic farmers making a loss has increased from 19% in 1997 to over 30% in 2002 (based on estimated profit) [National Farmers Union 2002]. Consequently, the percentage of organic farmers who are making a profit of over £10,000 has fallen from 56% in 1997 to 38% in 2002 [National Farmers Union 2002]. Subsidies paid to organic farmers participating in the organic farming scheme amount to only 3% of the £3 billion total annual spend on agri-environment schemes in the UK, compared to an average of 11% of total subsidy spend across Europe [Organic Europe 2002]. Further to the Curry Commission on the Future of Food and Farming [Department for Environment Food and Rural Affairs 2002], a press release through the

Department for Environment Food and Rural Affairs by government minister Michael Meacher [2002] announced that: -

- An extra £500 million will be invested by the Department for Environment Food and Rural Affairs over the next three years to deliver a sustainable future for farming and the countryside and thus implement the Curry Commission on the Future of Food and Farming core recommendations, and,
- Four pilot schemes in England are to be activated to test entry-level measures and identification of areas on farms requiring simple environmental management [Meacher Department for Environment Food and Rural Affairs Press Release 2002].

In response, the Royal Institute of Chartered Surveyors issued a press statement on the same day stating that 'Many of the environmental targets contained within these pilot schemes, such as increasing farmland birds, better hedgerow management, preservation of stone walls and reductions in soil erosion, are already being carried out by farmers participating in the existing Countryside Stewardship, or other agri-environment schemes. These farmers will not be able to gain access to the new money on offer as they are contracted to previous agreements. In addition they will have their production subsidies significantly reduced under the process called 'modulation' which will fund the new scheme if fully implemented. This will penalise the very people who have been doing their up-most to protect the environment up to now. Royal Institute of Chartered Surveyors published research into modulation in July 2002 stating that, "with certain farmers unable to access modulated funds, the findings showed a potentially devastating effect on farm incomes, as well as a possible negative impact on environments" [Royal Institute of Chartered Surveyors 2002].

Key concerns revealed in the National Farmers Union [2002] report, Organic Members Survey, are that organic farmers should recognise that they themselves need to gain a greater understanding of the market place and that the UK is more dependent on imported organic produce than any other European country [National Farmers Union 2002]. With imports of organic foods currently accounting for 75% of total sales in the UK and consumer confusion over labelling, all imported organic food must come from growers, processors or importers who are registered and subject to regular inspection; all importers must prove that, as follows [National Farmers Union 2002] :-

- The products they wish to import have been produced to rules *equivalent* to those laid down in Articles 6 and 7 of Council Regulation (CR) (Ecological Footprint) 2092/91 (as amended) Organic Certification [2000].

- Products coming into the UK from European Union countries do not require United Kingdom Register of Organic Farmers and Growers authorisation, provided that the producer or processor is registered with an approved organic certification body; neither is authorisation required if the goods inspection, certifying body and country of origin are listed in the Annex to Commission Regulation 94/92 (as amended). A United Kingdom Register of Organic Farmers and Growers authorisation is required if the products are to be imported from any other Third World

- country outside the European Union. Seeds, animal feedstuffs and cotton are subject to the same regulations [Department for Environment Food and Rural Affairs 2002].

The Organic Members Survey explored the different methods that organic farmers are currently using to market their produce. Over a third use wholesale markets, followed by co-operatives, with sales direct to retailers accounting for 15% [National Farmers Union 2002].

The National Farmers Union [2002] survey also asked whether farmers carried out any "value-adding" food processing to their raw produce to aid the marketing process. Almost 25% stated that they did, including butchering, peeling, juicing and cheese making [National Farmers Union 2002]. The Organic Aid Scheme, formerly the Organic Farming Scheme, is the outcome of a twenty-one point Action Plan prepared as a sequel to the 'Curry Report Farming and Food: A Sustainable Future' published in July 2002 to help home-grown organic food production develop sustainably [Organic Action Plan Group 2002]. The Organic Farming Scheme was administered by The Department for Environment Food and Rural Affairs, which provided the funding aid for applicants under the scheme [United Kingdom Register of Organic Farmers and Growers 2001]. However, the twenty-one point Action Plan advocated the establishment of a new Advisory Committee to replace United Kingdom Register of Organic Farmers and Growers in April 2003, to advise Ministers on European Union organic standards, their application in the UK and the approval of organic certifying bodies [Organic Action Plan Group 2002]. For many farmers, conversion to organic production is a more profitable option than conventional farming and the Organic

Advisory Service offers free advice via by the Organic Conversion Information Service [Organic Conversion Information Service Wales 2005]. Department for Environment

Food and Rural Affairs statistics concerning the organic agricultural sector for Wales, as at the end of June 2002, (updated September 2002) specify 609 farmers and growers and 99 processors and or importers registered through the sector bodies discussed section 3.2.3 [Department for Environment Food and Rural Affairs 2002]. The author made a telephone enquiry to Sutton [2002] at the Department for Food Environment and Rural Affairs office for the United Kingdom Register of Organic Farmers and Growers. Sutton [2002] confirmed that statistics were being prepared to determine the location of all certified organic producers and processors in Wales, together with the sector body with whom they were registered. The information was made available after April 2003, when United Kingdom Register of Organic Farmers and Growers had been disbanded Sutton [2002]. Table 3.4 demonstrates the number of farmers and growers, processors and importers registered as organic in June 2002, within the UK and Table 3.5 illustrates the total number of registrations for all sector bodies to include conversion statistics. It is, at present, not possible to extrapolate Welsh statistics regarding individual locations.

3.2.5 Organic produce retailing

Growth in the organic food and non-alcoholic drinks market has resulted in a dramatic increase in market values since 1996 Mintel [2001]. This has come about against a background of minimal value growth in the overall food market Mintel [2001]. Even when constant prices are reviewed, the organic sector increased almost fivefold in value between 1996 and 2001. [Mintel 2001] estimated the value of the 2000 market at £727 million, with growth estimated at 35% during 2001. This resulted in retail sales of organic food and non-alcoholic drink of £980 million, shown in Table 3.2.

Table 3.2 Retail distribution of Organic food and soft drinks by distribution channel and value. 1999 and 2001

	1999		2001 (est)		% point	%
	£m	%	£m	%	change	change
					1999-2001	1999-2001
Grocery multiples	396	71	745	76	+5	+88.1
Local and direct sales*	93	17	137	14	-3	+47.3
Independents	55	10	78	8	-2	+41.8
Other**	10	2	20	2	-	+100.0
Total	554	100	980	100	-	+76.9

Source Mintel International 2001

Table 3.3 shows growth in the organic food and non-alcoholic drinks market from 1996 to 2000 and the estimation for 2001. Table 3.4 shows division of the organic market by segment for 1999 to 2001 which, overall, demonstrates an increase of 76.90%, but the author's interest is the increase of 34.00% recorded for fruit and vegetables.

Table 3. 3 UK retail sales of Organic food and non-alcoholic drink 1996-2001

Year	£m	Index	£m at	Index	m	Index
1996	200	100	200	100	242	100
1997	270	135	270	135	402	166
1998	390	195	385	192	581	240
1999	554	277	540	270	842	348
2000	727	364	713	356	1,200	496
2001 (est)	980	490	951	476	1,499	620

Source Mintel 2001.

Table 3.4 Retail sales of Organic food and non-alcoholic drink, by type, 1999 and 2001

	1999	2001	% Change 1999-2001
	£m	£m	Change
Fruit & vegetables	303	406	+ 34%
Dairy	55	154	+180%
Prepared foods	58	147	+153.4%
Bread & cereals	40	88	+120.0%
Meat & poultry	53	83	+56.0%
Baby food	27	55	+103.7%
Non-alcoholic (soft) drinks	12	29	+141.7%
Eggs	6	18	+200.0%
Total	554	980	+76.9%

Source Mintel 2001.

Since 1999, sales of organic products have grown, partly due, notes Mintel [2001], to the increasing product range. However, the share taken by fruit and vegetables has fallen since 1999, as a direct result of the increasing number of organic products competing for share of consumer spend. The Soil Association Food and Farming Report [2002] describes an increase in the sale of organic fruit and vegetables.

The growth of organic food production has been slow and remains a minor sector of total agricultural production within the UK; Mintel [2001] and the Soil Association, [2002] believe that demand is market led, due to the poor level of financial support for land conversion. However, as discussed in this chapter, the situation was heading for change from April 2003 when Department for Environment Food and Rural Affairs planned to introduce ongoing subsidies over five year periods It should be stressed however that there are no subsidies available for vegetable food crop production but only for conversion of land to organic status. This new scheme will alleviate the current problems within the present scheme under which there is no ongoing funding provision sometimes leaving growers to ride out long periods without income [Department for Environment Food and Rural Affairs 2002].

Table 3.4 shows that the biggest cash turnover for organic foods is for fruit and vegetables, with a sales figure of £406 million in 2001 but also records a reduction in sales of fruit and vegetables of 14% from the 1999 figure [Mintel 2001]. The imports therefore accounts for some £345.1 million. As mentioned before, in previous chapters, much of this imported vegetable food provision could possibly be grown on small land plots on a local basis to provide many socio-economic benefits to communities. According to Mintel [2001] the grocery multiples are said to be responsible for 76% of total retail sales of organic food and are taking an increasing share of such sales.

3.3 In Summary

Development history of organic growing practice has identified progress concerning recognition of the necessity to regulate, by Government licence, standards to ensure the production of healthy food. Case studies have highlighted the dramatic increase of retail demand for food devoid of chemical substances, where production methods contribute to sustainability and the health of soil, human and animal life. The Department for Environment Food and Rural Affairs has shown awareness for the need of additional help for farmers/producers and provided funding to facilitate test measures in order to implement recommendations from the Curry Report on the Future of Food and Farming [Department for Environment Food and Rural Affairs 2002]. However, as discussed, the process of modulation within the agricultural system in the UK has been questioned by the President of National Farmers Union Wales 'modulation is simply not acceptable, voluntary modulation distorts competition between European Union member states' [National Farmers Union of Wales 2001]. 'Department for Environment Food and Rural Affairs should put additional pressure on the UK Treasury to increase or backfill modulation Countryside Alliance [2001]. Different interests, as always, have opposite priorities and, whereas the Countryside Alliance 'looks to promote rural livelihoods to include the farming community, it strongly believes the environment is to be protected' Countryside Alliance [2001]. The National Farmers Union Wales, believes that 'We must be able to produce branded Welsh foods of the highest quality and to the highest standards competitively, as well as invest in the environment and a balance has to be struck between the two' [National Farmers Union Wales 2001]. The effects of fiscal policies on organic foods are evident. The new Organic Farming Scheme was so successful that it had to be closed during the year 2000 as the entire budget had been spent, a new budget became available in 2001 [Mintel 2001]. Organic registration and conversion continues to rise and, in 2002, doubled that of 2001 [Soil Association 2002]. The criteria for organic registration has been shown as discriminatory toward small growers with land holdings below one hectare, which has led to the formation of the Wholesome Food Association, whose members follow organic growing principles to produce food that cannot legally be recognized as organic. A fundamental need for more conversion of land to organic standard is made clear. It is apparent that the organic industry is well regulated by a number of certification bodies, under the auspices of a governmental authority, overseen by Department for Environment Food and Rural Affairs. However, registration with the Wholesome Food Association appears as a satisfactory compromise for small producers in need of lower costs.

3.4 Conclusion

This chapter has shown that there is an increasing demand for organically produced food within the UK. However, a major concern is the lack of home produce and the problem of pollution from transportation of organic produce from outside the UK. There is a strong argument for localized vegetable food crop production by a sustainable and profitable method to help meet the ever increasing demand for organic produce described in this chapter, and indeed, to reduce pollution from intensive agricultural practice discussed throughout this thesis.

CHAPTER 4

ALLOTMENTS

Chapter 4: Allotments

4.1 Introduction

Chapter 1 discussed land as a finite resource and considered both land use and mis-use together with a range of environmental issues. It was suggested that fresh UK grown food should be considered as an important factor in the use of vacant allotment sites and other small land plots. Chapter 1 also outlined the basis of this thesis as a means to promote and test a theory that benchmarks can be developed for the growing of vegetable food crops by such as schools and other communities. The work is about developing the idea within Wales to encourage and develop sustainability through localisation. Chapter 2 discussed methods of production and distribution for imported and home produced vegetable food crops by the diverse methods of intensive and integrated horticulture it was suggested that localisation and cultivation by non-intensive methods is a sustainable option.

Chapter 3 was devoted to the historical background of organic production in the 20th century and the rationale for registration. Control of organic producers and importers, through to the present day was considered. The increasing demand for and retailing of organic produce was also discussed. This Chapter will describe the history and use of allotment sites within the UK and will briefly outline allotment law. Methods of cultivation including pesticide and insecticide use are also briefly examined.

4.2 Allotments overview

Although history shows a long record of allotment cultivation in the UK, the most publicised usage must have been during the two World Wars. The twentieth century history of allotments reveals a decline in plot holders and lack of research into chemical use in cultivation. The sustainability of tenancies, due to changes in legislation favourable to developers is also evident, "Landlords and local authorities are always tempted to sell the land of allotments due to the value of the land and pressures from developers" [Perez-Vazques 2002]. Resistance to organic production by organizations with vested interests in chemical products and world-wide food supply have been identified as less than beneficial to small scale sustainable agriculture.

However, the author is sure that in the future allotments will be just as important in a traditional role, but sites and plots should also be used for educational purposes to promote healthy diets, exercise and sustainability through localisation in both rural and urban areas.

Cuba has a unique system of urban cultivation by organic methods which produces 60% of the nation's vegetable requirements [Schwarz 2002]. Most of the food grown between buildings, and on patios in Cuban cities is consumed within those cities. Rural areas have small market gardens and larger farms which make up the shortfall [Schwarz 2002]. The blockade of Cuba by the United States of America and the subsequent cessation of chemical fertilizer and pesticide imports from the former Union of Soviet Socialist Republics created the need for self sufficiency within Cuba [Schwartz 2002]. The Cuban situation has created 200,000 jobs within the country and production of vegetables has risen from seven grams per head of population in 1996 to the 2002 level of 450 grams per head [Schwarz 2002]. In the year 2000 every square metre of spare land in Cuba produced 27 kilograms of vegetable food crops and a yearly increase of 30% is expected year on year [Morsbach 2001].

From Cuba's success, lessons in sustainability can be learned and practices used there should be tried and tested in the UK.

4.2.1 History of allotments

Allotment plots have been a feature of the UK since the Reformation about 1558 to 1603 (the Reign of Elizabeth 1st) when manorial common land was enclosed, indeed, there is evidence that some Celtic fields in Cornwall, that were allotments circa 100 BC, which are still in use today [Humphreys 1996]. The Industrial Revolution promulgated urbanisation as workers moved from rural areas and required land to grow food crops for sustenance and various Acts of Parliament (1845, 1887 and 1907) were enacted to provide such facilities [Humphreys 1996].

Hepburn [2001], states that The Defence of the Realm Act of 1916 empowered local authorities to requisition for allotment purposes, any small pieces of open space, including playing fields and un-developed land. During the two World Wars the use of allotments grew very quickly [Her Majesty's Government 1998]. From 1914 – 1918 the 'Every man a Gardener' Campaign grew from 600,000 to 1.5 million participants [Her Majesty's Government 1998]. After the First World War, in 1918, the national demand for allotments diminished and many thousands of acres, temporarily requisitioned, were returned to their original use [Hepburn 2001]. However, the demand for allotments from returning ex-servicemen continued unabated particularly due to the economic conditions and the Land Settlement Facilities Act of 1919 which was aimed at helping them [Hepburn 2001]. This latter Act finally deleted references to the "labouring poor" and made it clear that all members of the community were eligible to take up allotment gardening.

During World War 2 allotments partly because of rationing and food shortages were by necessity widely used. From the author's own experience Her Majesty's Government of the time used the slogan 'Dig for Victory' to encourage home production of vegetable food crops and allotment holders produced 1.3 million tons of fresh produce a year therefore playing an important part in winning the war [Her Majesty's Government 1998]. Indeed, during 1939-1945 fresh food availability was limited in many ways due to wartime difficulties and the 'Dig for Victory' campaign played a significant part in survival for many families including the author's. A broadcast by the Minister of Agriculture on 4th October 1939 proclaimed that; '500,000 more allotments properly worked will provide potatoes and vegetables that will feed another million adults and 1.5 million children for eight months of the year, so let's get going and let "Dig for Victory" be the matter for everyone with a garden or allotment and every man and woman capable of digging an allotment in their spare time' [Crouch et al 1994]. The author observed that housing developments by local authorities after World War 2 usually included large gardens. Many tenants cultivated their gardens to grow vegetable food crops thereby partly replacing the need for allotments. Demand for allotments declined and in 1949 the Government–sponsored Allotments Advisory Committee sought four acres of allotment for every 1,000 people in the UK: making 200,000 acres

– in fact there was only 67,804 acres and between 1950 and 1964 the number of allotments fell from 1.1 million to 729,000 [Her Majesty's Government 1998]. In the late 1970's and 1980s, allotment gardening suffered a further setback when people turned en masse to supermarkets to buy their vegetables [Her Majesty's Government 1998]. With the environmental push and food scares of the 1990's, plus a growing elderly population more interested in gardening, demand for allotments is once again growing [Her Majesty's Government 1998]. Crouch [2003] states that allotments have become fashionable and that the physical exercise that allotment cultivation affords is important. Crouch [2003] also states that health benefits may be greater than this because of environmental concerns allotments were again considered a healthy production alternative to mass produced and imported vegetable food crops.

The reader may ponder the effects of a future crisis situation when borders are restricted when vegetable food crops are imported and production in the UK is being reduced to ensure that large supermarket groups maximise profits from cheaply produced foreign produce; 'Big chains often purchase their supplies directly from producers on the other side of the world' [Monbiot 2000]. The author believes that present and future world political situations, including the risk of war, may effect production, export and import of commodities, which people in the UK accept as being obtainable on a year around basis. Self sufficiency, as proved in recent history, is a prudent lifestyle, especially with regard to food supplies. There could be a need for the enactment of a 2006 Cultivation of Vacant Spaces and Derelict Allotment Facilities Act, or something similar, as a driver for community projects growing vegetable food crops. Any new act could incorporate grant facilities and, additionally cultivation standards modelled on organic ethics and benchmarks developed from recent research on sustainable principles.

Management and use of allotments is now controlled by the Allotment Act 1908, which consolidated and repealed all previous acts and is administered by local authorities [Humphreys 1996]. As an umbrella organisation for allotment holders and small gardeners, The National Society of Allotment and Leisure Gardeners as it is known now, was formed in 1901 as the Agricultural Organisation Society [The National Society of Allotment and Leisure Gardeners 2002]. The aim of the society was, and still is, co-operation amongst agriculturists and the organisation of small holdings and allotments. The National Society of Allotment and Leisure Gardeners maintain the origins of its UK heritage by providing a united voice and action to protect and preserve a traditional way of life [The National Society of Allotment and Leisure Gardeners 2002]. However, 'The allotment in Birmingham has seen increased participation of ethnic group' [Crouch et al 1994]. 'The extent of Asian and West Indian involvement is significant' [Crouch et al 1994]. 'They bring with them a commitment to cultivation that involves the whole family' [Crouch et al 1994]. 'In Handsworth (Birmingham), it is estimated that sixty per cent of plots are rented by Asians and fifteen percent by West Indians' [Crouch et al 1994]. Many ethnic groups use allotment sites to produce vegetable food crops to which they were accustomed in their homeland. Sweet potatoes are an example but in the main, Middle Eastern herbs and flowers are cultivated [Crouch et al 1994]. 'Allotments are increasingly multi-cultural, multi-ethnic and drawn from many different parts of the community, [Crouch 2003]. 'Stands of okra and large beds of spices and specific ways of growing crops mark individual and cultural identities, making plots distinctive and diverse and providing the catalyst for new networks between plot-holders, for whom sharing a site may be the only means of contact and mutual discovery' [Crouch 2003]. Their allotment produce is a contribution to domestic financial prudence, good health, cultural contact with their origins, import reduction and, as a consequence, sustainability [Crouch et al 2003].

There are clear signs of resurgence in urban allotments, fuelled in part by the general popularity of gardening and public concern over food safety [Wiltshire et al 2001]. Apart from their domestic use for sustainability benefit, allotments, states Wiltshire [2001] 'must be tailored to contemporary needs if they are to hold their ground.' The Medical Foundation for the Care of Victims of Torture uses allotment plots and Remembrance Gardens for working with psychotherapy and nature to rebuild shattered lives [Linden et al 2002]. Crouch [2003] regards allotments as sacred places associated with art, craft, human relationships and politics, and the Arts Council recently funded Tom Marshman, an allotment holder, to produce a theatrical performance on his plot, which attracted an audience of some forty people [Opperman 2004]. THRIVE is the national horticultural charity that exists to enable disadvantaged, disabled and older people to participate fully in the social and economic life of the community, by providing raised beds on allotment sites [Thrive 2004 and Wiltshire et al 2001]. The author regards allotments as places of truly UK culture, of important holistic educational value and transferable practical skills and concepts and as such, a contributor to social cohesion.

However, there are many problems facing existing allotment societies in the UK, at the beginning of the 21st century it is not uncommon to find 20% or more vacant plots on existing allotment sites [Quality Environment for Dartford 2002]. Indeed, the author has visited a number of allotment sites within the Pontypridd area of Wales and observed that many sites in ideal situations are overgrown and others have the appearance of systematic neglect and under use. Additionally, there are many other vacant land plots on housing estates and in other urban situations which are unused. In some instances a finite resource is used for illegal dumping of rubbish, (commonly known as 'fly tipping') or subjected to secondary succession by weed and nettle, which do provide wildlife habitat, although vermin are more usually present.

Vacant small land plot sites other than allotments appear to be unlisted or unrecorded and could be surveyed and adapted for use. It is fundamental that such a valuable and finite land resource should be used to full capacity in furtherance of growing vegetable food crops. The application of sustainable principles and benchmarks to enhance profitability could encourage such activity. Considerable advantages exist for healthy eating and community cohesion, coupled with the reduction of pollution from intensive food production and transportation associated with the purchase of food from monoculture systems and importation by multiple retailers. The absence of individuals prepared to cultivate vacant plots provides an opportunity for the development of community organic growing projects modelled on successful projects, such as in Cuba. Cuban vegetable food crop production methods have been the subject of much research because many horticulturists, economists, and others, have been surprised at the country's survival over 40 years of the United States of America trade embargo [Dinham 1996] and [Sinclair et al 2001]. All Cuban produce is grown without any help from chemical fertilizers, pesticides or herbicides [Dinham 1996] and [Morsbach 2001]. According to Morsbach [2001] annual production of fruit and vegetables is growing at

250% per annum, and the Cuban organic support group in the UK [Cuban Organic Support Group 2003], states that on average a one hectares plot of land, given by the Cuban government to anyone wishing to cultivate it produces 27 kilograms of vegetable food crops/m^2. If this production rate is compared with the study at Harlow Carr in 1975, where 652 kilograms of produce were produced on a plot of 333 m^2 (1.95 kilograms/m^2) [Morsbach 2001], it is shown that the Cuban approach is 13 times more efficient than that of the 1975 Royal Horticultural Society experiment. Cuba's horticultural system is divided into groups to facilitate production in kitchen gardens, hospital and school environments and larger co-operative organizations [Walljasper 2002]. A law passed in Cuba in 2001 makes organic farming compulsory and prohibits food production by any method other than organic [Morsbach 2001]. Whilst the Cuban system uses all spare land for organic food production for home consumption and is self sufficient in all crops, including vegetable food crops, it is interesting to note that the ecological footprint of Cuba is set at 1.5 hectares per capita; the Ecological Footprint of the UK is 4.72 hectares per capita [Venetoulis et al 2004]. As can be seen in Chapter Two, manufacture, transportation and use of chemical substances in crop production in the UK increases the UK Ecological Footprint significantly.

In the UK it is not certain whether current allotment holders understand, or indeed wish to follow organic methods, and the sustainable principles that 95% of all activity must be undertaken using natural biological methods [Department for Environment Food and Rural Affairs 2002]. It is suggested that benchmarking, perhaps followed by relevant legislation to provide funding and an organic support system, allotment gardeners, community groups, schools and hospitals, could emulate aspects of the Cuban system.

In 1993, The National Society of Allotment and Leisure Gardeners was funded [Department for Environment Food and Rural Affairs 2002] to conduct a survey in England and Wales to generate information on the characteristics of allotment holders, patterns of allotment use, the allocation process, costs incurred by allotment holders, facilities on sites and problems identified by those with allotments [Saunders 1993]. The report does not detail production quantities or value, but provides details of Insecticide, Fungicide and Weed-killer by user percentage by allotment holders for the whole of England and Wales (see Table 4.1 below) [Saunders 1993]. A further survey on allotment sites was undertaken in 1997 by Crouch [1997] which discussed the availability and services attached to running an allotment, but only for England, and concluded that such a survey should be undertaken in Wales. The Saunders [1993] survey is the only one of its type the author has been able to source during this research, but awareness of chemical residues and environmental pollution during the decade until the present could have influenced many allotment gardeners to reduce or even abandon chemical usage. Table 4.1 shows percentage of allotment gardeners participating in the 1993 Saunders survey using insecticides, fungicides and weed-killers with reasons and frequency.

Table 4.1: NSALG 1993 Survey

USE	INSECTICIDES	FUNGICIDE	WEEDKILLER
To Prevent	17%	22%	
To treat attack	58%	36%	
Never use	25%	42%	49%
Regularly			2%
Occasionally			26%
Rarely			22%

Source: Saunders 1993

Statistics for food production on allotment sites in the UK and the total number of allotment sites in existence are not available from The National Society of Allotment and Leisure Gardeners. The 1975 Royal Horticultural Society experiment at Harlow Carr is the only known specific statistical record, of vegetable food crop produce harvested on allotment plots, which the author has been able to locate [Stokes 2005]. The Royal Horticultural Society conducted trials on a 30 foot x 100 foot allotment plot 'with the aim of showing how vegetables for a family of four could be provided' [Stokes 2005]. Using Royal Horticultural Society records the present day value of the crops is calculated as only £745.00.

Pretty [2001] states that there are 300,000 allotment plots in the UK, yielding produce valued at £561 million which represents value of £1,870 per plot. Pretty [2001] does not detail allotment plot size, crop varieties or average crop quantities per allotment plot; neither does the work identify crop failure, and the value differentials which require detailed separate research. The English Allotment Survey [Crouch 1997] is the first survey of allotment numbers in England since 1978. It includes the number and size of plots, the number and size of sites, the extent of vacant plots and numbers of people on waiting lists for plots. There is no indication of crop quantities or the monetary value of production and the statistics published do not include any for Wales although a survey of Wales is recommended by [Crouch 1997].

Stokes [2002], indicated that there are 500 allotment sites, with 15,000 plot holders within Wales and 180 Welsh allotment societies with a total membership of over 4,000 people, represented by The National Society of Allotment and Leisure Gardeners. Stokes [2002] states in an email of 14th June 2004 to the author (Appendix 2) that 'the estimate was based on population multiplied by the aver age provision for England' and added 'that it was not very scientific, but the best we could do'. It has been suggested by Stokes and others that a full survey should be conducted to provide reliable scientific data.

A personal interview survey with five allotment holders within the South Wales area, conducted during this research, has established an understanding of present allotment use, production methods, and cropping statistics some of which are included in the benchmark exercise discussed in chapter 5. Analysis of the allotment data collected is discussed in chapter 6.

The Select Committee on the Environment, Transport and Regional Affairs Fifth Report, 'The Future for Allotments', [Her Majesty's Government 1998] provides an objective assessment of practical therapeutic and the social environmental value of allotments. The document proffers planning and protection advice, but does not include statistical data relevant to production or crop values. It acknowledges that there are many conceptual and empirical problems attendant to the production of an accurate estimation of the total economic value of allotments

The Local Government Association [2001] recommends that restrictions banning the selling of surplus food crop produce and flowers grown on allotments should be lifted to facilitate supplies within nearby communities. Sensible management and accurate monitoring of practical application of the approaches provided by this thesis could be one measurement of economic viability, if that is to override other considerable benefits discussed above. Flower production could improve the appeal of allotments to gardeners who prefer floral crops to vegetables. Some reduction of diesel pollution levels could be achieved by reducing or banning the use of articulated vehicles from Holland. Dutch vehicles carrying floral imports into the UK are of considerable size and labelled as weighing; some 45 tonnes and 14 meters in length. Dutch and sometimes other lorries often block narrow streets outside of florist shop premises whilst delivering flowers in South Wales's towns and villages. It may be possible to grow the same or similar flower varieties on a local basis for aesthetic enhancement of vacant land plots and the reduction of diesel particulates. Flowers can also be used to attract natural predators away from vegetable food crops, such as aphids, which, as an example are attracted to tomatoes. For instance, planting of marigolds next to tomatoes will attract hoverfly which prey on aphids [Neville 2004]. Onions planted close to carrots will deter carrot fly attack [Neville 2004]. The process is known as companion planting and is used in many situations in private and commercial growing enterprises.

If, as suggested above, legislation was introduced to permit commercial trading or even local institutional and community use of locally produced vegetable food crops, flowers, craft grasses and coppice there would be a need for standards and benchmarks to facilitate integrated growing, management and distribution. Having reviewed the various methods for producing and distributing vegetable food crops and reached an understanding of the detrimental effects ensuing, the author developed a personal interview questionnaire to apply horticultural benchmarking techniques to small scale community vegetable food crop production. The method and rationale for the establishment of benchmarks is discussed in chapter 5.

4.3 Conclusions

This chapter has discussed the history and use of allotment sites within the UK, and identified that a study is required to be undertaken in Wales to establish the availability

and services needed to successfully managing an allotment. The discussion suggests that allotment plots have been a useful feature of UK life in terms of providing vegetables in the past, particularly at times when there has been a shortage of food, and could therefore be a useful asset to a sustainable community in the future. In addition, it is shown that if allotment site cultivators and other producers follow organic principles adopted in Cuba, allotment sites in the UK could be up to 13 times more efficient in the vegetable food crops produced per m^2 than previous studies undertaken of allotments has revealed. Benchmarks could promote that efficiency through the benefits of more profitable outputs possibly using a method of input reduction.

CHAPTER 5

RESEARCH METHODOLOGY

Chapter 5: Research Methodology

5.1 Designing a benchmarking study

5.1.1 Introduction

Chapter 1 of this thesis discussed the rationale and purpose of the work and its' connection to global environmental pollution issues attributed to agriculture generally. Both Localisation for sustainability and the social cohesion of communities were discussed. The objectives of this research were stated and the anticipated contribution to knowledge as a result of work undertaken was explained. A brief overview describes the contents of each of the chapters.

Chapter 1 sought in section 1.5 to define localisation and section 1.5.1 the relationship between localisation and vegetable food crop production. Section 5.2 provided an overview of the ecological footprint followed by section 5.3 which gave a brief account of social cohesion relative to small scale communal vegetable food crop production. Chapter 1 section 1.5.4 describes the effects of pollution from food transportation by different, and for some, unsustainable methods.

5.2 Rationale

It is intended, from this study, that methods will be established to record information relevant to production costs, methods, and cropping values of vegetable food crops to create benchmarks for exchange and use between small community producers of vegetable food crops. The benchmarks created will aid efficiency by the pooling of knowledge and the reduction of distribution and other costs with the ultimate goal of sustainable localised production and consumption. The practicability of benchmarking for vegetable food crops production on small vacant land plots cannot be tested without the availability of empirical facts pertinent to growing and harvesting practices. The ultimate aim of this study is to develop a framework that can be used by community groups to establish the most productive methods to grow vegetable food crops for local consumption and sale. The data collected will be used to create a frontier (envelope) representing the 'best performance made up of the units in the data set which are most efficient in transforming inputs into outputs' [Hussain et al 2000].

5.3 Benchmarking

5.3.1 Definitions

Benchmarking for vegetable food crops production by small growers is defined by the author as 'a method of assessing performance of a peer group using diverse input and output variables of vegetable food crops production as a benchmark, to compare and adjust the inefficient producer's methods to attain efficient quality, quantity and monetary parity'.

Benchmarking is a simple idea, 'compare your measurements against others to find out where you lead and where you lag behind' [Food Chain Centre 2003]. 'It helps to prioritise areas for improvement and shows what gains are possible' [Food Chain Centre 2003]. The author believes that simplicity can only be found in processes of similarity of products grown in the same way. All growing is dependent upon a range of variables greater than in other production processes. These variables include anomalies of climate, soil type, land aspect, drainage and numerous others. The Food Chain Centre is funded through the Farmer's Fund, a registered charity, set up by the supermarket groups Asda, Marks and Spencer, Safeway, Sainsbury's, Tesco, Somerfield and Waitrose [Food Chain Centre 2003]. Through the Food Chain Centre, *Hortbench*, a farmers benchmarking system, it is intended to provide, and establish, a national strategy to improve the competitiveness and profitability of farming. Farmers are asked to join a group and swap ideas by declaring all of their business details on an internet site [Food Chain Centre 2003]. Resultant Hortbench [2003] spreadsheets for data input show detailed costs of production and distribution.

Recent media reports (discussed in Chapter 2 section 5) have suggested that supermarket groups are forcing farm gate prices for food down to a level below production costs and therefore unprofitable to producers in the UK. The information provided by farmers through the Food Chain Centre could exacerbate the problem by providing supermarkets with data detrimental to the UK producers providing it. The net result could be a reduction of UK producers by demands for cheaper produce by the supermarkets, which UK growers are unable to resist due to an increase in cheap imports. Conversely a revelation through data provision by farmers that the prices paid by supermarkets are too low may bring about a change in attitude by the supermarket groups and encourage them to be more realistic in their dealings with growers. Hortbench [2003] could, as their publicity folder 'benchmarking' states 'promote better management of cultivation and distribution methods to producer's advantage and make some more competitive and improve the competitiveness and profitability of UK food and farming'. However, in view of the methods employed by supermarket groups, as detailed by Blythman [2004], and others, to continually advance profitability and domination of the market, the author considers any options above as beneficial to growers unlikely, unless some form of regulation is applied to vegetable food crops and other edible imports. Focus [2004], reports that the Hortbench [2003] 'benchmarking' scheme has notched up success, because a £335,000 grant has been obtained from the British government to promote benchmarking to as many farmers as possible in the UK. Between 2003 and 2004, since the formation of Hortbench [2003] only 8% of farmers in the UK participated in the scheme [Focus 2004]. Perhaps, farmers in the UK share the same scepticism towards the Hortbench [2003] scheme as the author.

'Benchmarking' is a practical tool for improving performance by learning from best practices and the processes by which they are achieved' [European Union (Benchmarking Co-ordination Office) 2001]. 'In this way benchmarking helps explain the processes behind excellent performance', in addition and 'when the lessons learnt from a benchmarking exercise are applied appropriately, they facilitate improved performance in critical functions within an organisation or in key areas of the business environment' Further, 'benchmarking involves looking outward (outside ones own company, organisation, industry, region or country) to examine how others achieve their performance levels and to understand the processes they use'[European Union (Benchmarking Co-ordination Office) 2001]. Initial research by the author has shown that benchmarks are available for organic field crops as published in the annual Organic Farm Management Handbook [Lampkin et al 2002]. Details include output price, yield and variable production costs and weed and disease control methods and appropriate storage facilities [Lampkin et al 2003]. Lampkin et al [2003] state 'many horticultural crops are only profitable if the performance is good (performance is high yield and high price, low labour and low marketing costs), which requires production and marketing to be kept under constant review. The potential returns can be high, but it is likely that in any one year on average 10-20% (more for some crops such as lettuce) of produce grown will not be marketed because of weather, pests or over production'.

The percentage of crops grown and not marketed may be acceptable in large commercial production enterprises with a built in contingency for the eventuality of failure or non marketability, but, in instances of small production areas, a different view needs to be taken. Firstly, on small plots cultivation is by manual methods and the grower is closely connected to the growing process. A variety of crops are grown in rotation on small plots as opposed to the mono-culture situation of commercial holdings. In the author's opinion, on small growing areas within communities, there will be the important considerations of the non market benefits: fresh air, enjoyment, relaxation and recreation with a profound interest in fresh healthy food and the enjoyment of tilling, planting, watching the growing process, and participation in harvesting followed by healthy eating. The crop therefore should not be over produced and under consumed having been cultivated for reasons other than profit, but the eventuality of crop failure in any horticultural practice is always a threat. Even so, the monetary value of vegetable food crops grown in community situations to benefit sustainability must still be considered within the proposed benchmarking process. Cost considerations will occupy a large part of the benchmark analysis to benefit the community producers and consumers. Those dependent or semi-dependent on the produce will require recognition for such as community supply, instances of purchase and to satisfy the systems of accountancy applicable to individual establishments.

Similarly, community members undertaking the physical tasks of cultivation need to be aware that apart from the non market benefits their labour time is worthy of consideration. Those without employment are subjected to different economic forces and possibly less time constraints than full-time or even the part time employed. The basic question is that of the minimum wage in paid employment and the value of vegetable food crops produced per person per hour of labour in the cultivation process. The author believes that unemployed persons or those working part time could benefit economically from community produced vegetable food crops with an added bonus of healthy exercise and a move toward a chemical free diet. Those in lower paid occupations may well be able to produce vegetable food crops of a greater value for a working hour than the minimum wage.

It is intended that the benchmarking process developed in this thesis will evolve from data collected from small scale producers, whereas the Hortbench [2003] system is intended for field crops and animal husbandry and is founded upon large agricultural enterprises. In the process of this study small producers will not be required to divulge the details of their businesses to competitors or indeed, to supermarkets. The results of collation and analysis of production and business details will be used in a different way to that of Hortbench statistics and will be discussed in Chapter 6.

The Soil Association Organic Food and Farming Report [2003] details an overview of organic vegetable food crop production in the UK by Soil Association organic registered producers together with retail sales figures and crop imports. Additionally an overview of organic growing trends and marketing is outlined by the Soil Association [2003]. There is no indication of individual plot yields, or benchmarks, but a record of total organic vegetable food crops production volumes and values are detailed. The Soil Association publishes a guide for registered vegetable food crops producers indicating attained and estimated expected crop levels. The guide is not available to persons not registered as organic producers with the Soil Association. Therefore, as a result the author has not been able to secure a copy of this document.

5.3.2 World-wide organic benchmarking record

According to Faerge et al [2003] the Danish Research Centre for Organic farming has recently initiated a number of crop rotation experiments intended to serve as long term organic farming benchmarks. The experiment consists of a six year rotation with barley in the first year and in the second year clover ley, barley, pea, ryegrass, winter wheat and fodder beet [Faerge et al 2003]. Comparisons were made with conventional farm production methods with a view that the entire Danish agricultural system should become organic experiments concerned solely with soil fertility from organic and artificial nutrients. Unfortunately, the results were inconclusive for complex reasons described in detail by Faerge et al [2003] and, therefore, are of limited use for inclusion within this research project. Kumm [2001] reveals that Swedish comparative studies of conventional and organic agriculture find that 'future technical progress might make organic production very competitive in dairy, beef and sheep production.' 'The conditions are not so optimistic in cereal, oilseed, potato, sugar beet, pork and poultry production' [Kumm 2001]. This work makes no reference to vegetable food crop production or the benchmarking of any farming production. The purpose of the study was to survey what Sweden may look like in the future if it becomes ecologically sustainable, and the nature of the path towards a better environment and improved sustainability [Kumm 2001]. Lotter [2003] reviewed the agri-ecological characteristics of organic agriculture relevant to weed, invertebrate, disease, and soil fertility management practices on American and European farms. Lotter [2003] has stated, with Myhill [2003] that yield reduction of organic agricultural systems relative to conventional agricultural systems averages 10% to 15% and organic systems consistently out perform conventional agricultural systems in drought situations [Lotter 2003]. The Lotter [2003] review covers production and profitability comparisons based on conversion costs, produce demand and environmental costs, benchmarking as such is not considered for the overall improvement of any agricultural practice.

5.3.3 Benchmarking organic vegetable food crops production in Wales

Since 1998, the UK government [Her Majesty's Government (House of Commons 5th Report) 1998] recognised that local food production brings environmental benefits, however no funded action appears to have occurred to promote such activities. Also, the study [Her Majesty's Government (House of Commons 5th Report) 1998] reveals minimal availability of detailed data on which to base small scale vegetable food crop production on vacant land plots within communities, on a co-operative basis, through local community growing associations.

Food provision, marketing and connected environmental awareness, demands a continuous re-appraisal of agricultural production, policies and practices to influence and guide producers toward a more localised system of vegetable food crops production within the UK and in particular, for the purpose of this work Wales which is in the main, sparsely populated. The Footprint for Wales Report [Best Foot Forward 2002] states that Wales has a resident population of 2,946,200 which is expected to rise to nearly 3,000,000 by 2011. The report Footprint for Wales [Best Foot Forward 2002] also states that the land area of Wales extends to 20,778 km^2; of which 1,633 km^2 is committed to agriculture. Eighty per cent of agricultural land in Wales is classified as Grade 4 or 5 as described in Table 2.3 of the Upland Management handbook [Department for Environment Food and Rural Affairs 2001] which classifies Grade 4 as poor quality agricultural land and Grade 5 as very poor quality agricultural land. Woodland covers another 2,625 Km^2 [Best Foot Forward (The Footprint for Wales Report) 2002] with much vacant land space, albeit, that the geography of Wales is mountainous, but relatively unspoilt with three national parks covering almost 25% of the country, and over 100 nature reserves [Best Foot Forward (Footprint for Wales Report) 2002]. Motorway and trunk road construction is increasing and industrial sites with supermarket and fast food 'drive ins' are now becoming a feature in Wales. These developments could contribute to discouraging people in Wales from using localized productivity and encourage the use of the global market on a larger scale than at present. The need for localisation becomes more apparent from an environmental viewpoint when considering the wider implications of increased transport and infrastructure within urban and rural Wales. The author proposes that vegetable food crop production is an integral part of the localisation ethos and production by communities for home and institutional consumption could provide an important driver of the community and its diet. The need presents itself for the study of those facts relevant to small scale vegetable food crop production to test the usefulness of benchmarking.

5.4 Design

5.4.1 The research questionnaire

The questions that arise for designing an interview questionnaire in the first instance are as follows.

- How data of sufficient quality can be obtained from producers, large and small, many of whom may not keep accurate records.
- Which method of recording production activities of small producers should be used.
- By what methods can reliable benchmarks be developed from the data avoiding arbitrary start points.

The quantitative research as distinguished from qualitative research by [Oliver 1997] required is 'objective' in nature and composed of variables, measured in numbers and lends itself to statistical analysis [Chien 2003]. Oliver [1997] also points out that quantitative techniques seek data in a numerical format, which can then be analysed and presented by a variety of means, including tables, charts, graphs and statistics. Naoum [1998] suggests that quantitative research be selected under two circumstances. They are as follow,

- When one wants to find facts about a concept, a question or an attribute.
- When one wants to collect factual evidence and study the relationship between these facts in order to test a particular theory or hypothesis.

The questions posed above in relation to this study comply with Naoum's [1998] criteria and the ideas of Chien [2003] and Oliver [1997].

Having established that quantitative research is required, further questions now arise concerning the formulation of a personal interview questionnaire. The author deemed that such a questionnaire would be the most suitable and applicable method of obtaining the details required to complete the study. This is because growers of vegetable food crops are more likely to give information if interviewed in person face to face. However, Wheater et al [2003] remind us that 'in questionnaire design there may be sound reasons for not collecting the most detailed data'.

5. 4. 2 Informal discussions with hobby gardeners

Before compilation of a pilot questionnaire a circular e-mail was sent by the author, within the University of Glamorgan to locate academic and other staff, with an active interest in gardening and allotment gardening for vegetable food crop production. The response provided 10 persons willing to discuss their horticultural interests prior to them being subjected to a full personal interview questionnaire as a pilot. Informal meetings on a one to one basis indicated that as hobby gardeners, otherwise in full time professional employment, their horticultural interest was in fresh vegetable food crops, as indicated in the House of Commons 1998 report which states that 75% of allotment holders in the UK desire the fresh food and exercise. Financial constraints of high retail prices appeared to be of no concern to the hobby gardeners informally interviewed and this is substantiated by House of Commons [1998] 5^{th} report, entitled The Future for

Allotments, in which it is stated that less than 20% of allotment growers regard the financial aspects as important. Above all, the pilot sample of informal interviewees were keen to grow their produce to a high standard by methods devoid of artificial fertilizers and pesticides, and were willing to discuss their hobby in detail. The author realised that this method of initial research was subjective and, in terms of this study, only of use as a guide to gather an overview of the needs and wants of gardeners but more importantly to test the suitability of a personal interview questionnaire.

Because the University of Glamorgan hobby gardeners were not interested in the financial aspects when producing vegetable food crops at home or on allotments and were devoid of any other commercial aspects of growing, the trial questionnaire would have no requirement to elicit financial details from them but could concentrate on other cultivation aspects including crop harvest quantities. The main elements of their interest appeared to be centred on the practicalities of production within the constraints of land situation and which crop varieties could be successfully cultivated.

The informal discussions, founded on local knowledge and enthusiasm, provided a guide for the pilot questionnaire interview.

5.4.3 Pilot questionnaire

The author decided that prior to the compilation of a comprehensive questionnaire for use with growers in Wales, a pilot study should be undertaken locally. To establish benchmarks allied to the theory put forward by the author the following considerations were taken into account.

- What arrangements should be made to conduct pilot interviews with a selection of interviewees engaged locally in vegetable food crop production on a small scale.

- The need to decide on the type of information which would be required to establish benchmarks for small producers engaged in community horticulture. These groups may comprise of people with a lack of practical skills and horticultural knowledge, but inclined towards aspects of localisation.

- Requirement for comprehensive questions which invite straight-forward answers on an objective basis that can be analysed and collated for use as uncomplicated benchmarks.

- The selection of a software system for analysis, collation and assessment with the capability of dealing with a large number of variables.

- Methods of simple access to and understanding of, the benchmarking data, beneficial to those sections of the community most likely to benefit through practical application.

5. 4. 3. 1 Pilot questionnaire formation

According to Denscombe [1998] 'Questionnaire design, has three key issues. These issues will determine whether people take the time to complete the questionnaire.

- Simplicity of questions,
- length of questionnaire,
- presentation.

The pilot questionnaire was compiled with Denscombe [1998], Fellows et al [1997] and Chien [2003] in mind, using and elaborating upon the subjective information gained from the informal discussions previously discussed in section 5.4.2 above. Fellowes et al [1997] advise that questions should be, as follows.

- Unambiguous and easy for the respondent to answer: they should not require extensive data gathering by the respondent.

- Clear, each should concern one issue only and the request for answers should be given in an 'unthreatening' form appropriate for research.

Question formation required that various aspects of horticultural activity be divided into sections relative to specific research requirements. As an example a section on soil classification included 'soil type', 'drainage' and 'soil horizons'. Land aspect and land relief were each afforded places within a land situation section. Extensive questionnaire sections for crops and cropping over twelve month periods were restricted to one per crop type and included harvest quantities, [Pilot Questionnaire Structured Interview Appendix 3. The questionnaire was then piloted within the University of Glamorgan on a personal interview basis during July 2002, with a sample of five persons interested in growing vegetable food crops. These five, (four academics and one technical officer) were chosen to be interviewed because their gardening activities included all aspects of small scale horticulture and they were all predominately growing vegetable food crops. The resultant answers from all respondents indicated that certain aspects of the questionnaire required change. During the trial interviews it was revealed that some aspects of vegetable food crop cultivation were missing from the questionnaire. For example, the incidence of 'seed saving' and 'the costs of seed' and 'plant acquisition' or 'tool' and 'equipment' costs were not considered, but brought to the attention of the author by the interviewees. As mentioned above, financial constraints were irrelevant to the trial participants as were a number of other costs, but the matter was noted and those questions were later included in the business section of the growers questionnaire to be used in the analysis. Additionally, there appeared a requirement for the addition of further questions with regards to other costs which applied to 'irrigation', 'water storage', 'organic' and 'non-organic' fertilizer,' 'purchase' and 'insurance premiums'. A section covering the 'retail sales of produce', 'open days' and 'courses' would also need to be added as 'outputs' from 'holdings'. After the questionnaire was amended to include the missing and ambiguous elements a further section containing questions relating to all financial aspects of commercial vegetable food crop production and other produce (for example 'craft grasses' and 'honey') was introduced. The amended questionnaire contained a total of 128 questions with a possible 1667 variables being generated (Growers Questionnaire Appendix 4).

5.5 The Growers questionnaire

5.5.1 Overview

Structured interviews involve tight control over the format of the questions and answers [Denscombe 2003]. The author is also aware of the concepts of 'the information society' and the data protection legislation concerning the amount of data held by commercial and public agencies. According to the Information Commissioner's Factsheet [Her Majesty's Government Data Protection Act 1998], at least one of six conditions must be adhered to under The Data Protection Act 1998 to conduct a personal interview questionnaire for this research: in this instance the condition 'the individual has consented to the processing' will suffice [Information Commissioner Factsheet [Her Majesty's Government Data Protection Act 1998]. Webster [1995] infers that questionnaires should be confidential and anonymous. However personal information regarding the respondents is required for this survey. People's sensitivity about age for example was considered and the age question phrased accordingly by banding age groups. Similarly partners living and working together may not wish to disclose their marital status.

As far as the author can ascertain, no research into benchmarking for vegetable food crops production has been completed. Some of the questions and answers within this study may appear unimportant to the reader. On the basis that data of diverse types might be required for analysis for this or later studies the author decided to collect details of as many inputs and outputs as possible.

The structured interview questionnaire (Appendix 4) for this research was divided into ten sections. The first part consists of nine sections covering 95 questions with a total of 1657 possible answers. The second part comprises one section covering 33 questions with answers potential totalling 213. The purpose of the first part (sections 1-9) is to obtain a comprehensive appraisal of the 'gender' and 'age' of the respondent grower and full details of the land held and how it is used. It covers many variables including 'boundaries', 'access', 'soil classifications' and 'grower affiliations', which are of lesser importance than others for the purpose of this study. Full planting and cropping details on a month by month basis are considered and details include the 'monthly kilogram yield' of each product, to enable a calculation to be made of the monetary value using an average selling price of each product in the retail sector. By recording this data it would be possible to compare the 'turnover figures' provided by the interviewee in section 10. The questions for input and output data are mainly posed on a yes/no basis and cropping details by kilogram quantities produced. The data for planting/sowing and harvesting is organized on a monthly basis with a tick box option firstly to identify that a particular crop is raised and secondly, in which month and lastly, weight of crop harvested. Capital costs and produce input costs and sales income are recorded in monetary terms in section 10. Section 10 is the detail of the growers business and, as with sections 1 to 9 is confidential.

As can be seen in Appendix 4, variables covered are far in excess of those that are analysed in Chapter 6. The reason for this is that the author is aware that in future the results of the survey may be of use in other work and gathering such detail is time consuming and expensive, especially from the organizational and travel aspect emissions. Also, the method of aggressive data gathering gave the author a wide selection of information to select variables for analysis, which he considered the most important with the use of benchmarks in mind. It is interesting to note that all the participants interviewed co-operated fully to provide the data asked for. As chapter 6 section 6 will show, most data was from memory and consequently may to some extent be inaccurate; but at the time it was the best available and obtainable and given with good grace.

The author's intention that established benchmarks may be used by communities and small growers generally requires evidence of suitable rewards for input contributions. Therefore, the second section of the questionnaire required financial details of input and output in monetary terms. These details are for 'wages', 'services', 'insurance', 'land purchase costs' and 'rental charges' where appropriate.

5.5.2 Compilation detail

Section 1 of the questionnaire records a sample number for the interviewee and the date of interview for administration purposes – for example, a working list using a numbers from 1 to 40 (40 was the final interview number) would be less time consuming when analysing results and discussing each producer's performance. Question 1 and question 2 were posed to ascertain the 'ratio' and 'age groups' of 'male' to 'female growers' and the status of their 'mode of business' should that information be required in later analysis. Section 2 refers to 'land holding' which again, although question 3 is of minimal use in this study, the answer may be of use as a benchmark in other research, whereas question 4 'land area' is relevant to production quantities in this project. Section 3 question 5 requires the 'boundary situation' of the holding. Combined with other variables the situation of hedges or walls for instance may be considered as a help or hindrance to cultivation of certain crop types. The access referred to in question 6 may effect the position of provision for farm gate sales; such as vandalism or theft. Water use especially in hot summers can be an expensive commodity for growers and access to a natural stream, river or spring could considerably reduce input costs and question 8 asks for litres of water used on a monthly basis. 'Land aspect,' question 9, is connected to question 5. Basic gardening knowledge dictates that a south facing wall is an ideal environment for fruit growing. 'Topography' of the land (asked for in question 10) may affect irrigation or machine use during cultivation. Section 4 question 11 examines soil type which may affect the crop varieties suitable for a particular holding. Carrots grow more profusely in sandy soil and asparagus or peas, for instance, do not thrive on waterlogged ground whereas some potato varieties grow well in very wet situations on any type of soil [Hessayon 1998]. These eventualities are tied to question 12 which applies to 'drainage' whereas 'soil horizons' (question 13) will affect vegetables with deep or shallow roots. Question 14 concerns 'parent rock', another element that could be relevant to other studies but as far as the author is aware of limited use in this study. 'Soil tests' (question 15) requests details of tests for various chemical elements searched for by organic registration bodies before registration can take place. The 'pH' (soil acidity test) is undertaken by most gardeners who will be looking for a degree of acidity reading of 6.5 – 7, which means that the soil has sufficient lime content for successful growing results [Hessayon 1998]. Question 16 is posed to elicit the affiliations of growers to 'organic registration' or 'other organizations'. Question 17 seeks to establish the reason for grower non-participation in organic registration. As will be seen in chapter 6, registration is a costly event for small businesses. 'Previous land use' is dealt with in question 18, again for no specific reason other than such data will be useful for other research in common with question 19. Section 5 questions 20, 21 and 22 examine 'pest' and 'disease control' by 'natural, organic-biological' or 'inorganic methods' and Section 6, questions 23 and 24 examines 'organic' and 'inorganic nutrients'. These details could be used in other research whereas in this project the input costs of pesticides and fertilizers only are considered. Section 7, question 25, the data will be used in chapter 6 because the answers denote the 'types of crops' cultivated by the respondent. The author has categorized crop types and other outputs to cover all eventualities for easier assessment of each grower's performance for each category. Question 26, in the same section asks for data relevant to 'labour hours' for 'crop production'. Section 8, comprises question 27 to question 92 through the categories already mentioned above. These questions all ask whether or not the category of produce is grown and in which month it is planted and harvested with provision to state the quantity in kilograms for vegetable food crops, soft fruit and herbs. Salad leaves are included as leaf vegetables. In the example of flowers (questions 78 to 83) the data for produce quantity is requested in bunch numbers with 10 the average number of blooms to the bunch. Plants and bulbs (questions 84 to 86) are counted on an individual basis for all varieties of bedding and house-plants. Question 87 is titled 'other plants' to include varieties such as tomato, broad and runner beans or 'what have you' with facility to declare total plant number. Outputs, perhaps produced by few growers, comprise questions 88 to 92. These include 'willow', 'hazel' and 'other craft goods' with the facility to enter monetary value as opposed to weight. The detail of produce kilogram yield, and flower bunch numbers discussed above, provide the ability and opportunity to verify the turnover figures given as answers to Section 10 questions because, as, writes Gillham [2002], it is 'impossible to check the seriousness or honesty of answers'.

Question 93 is a 'yes/no' question for 'honey production' and 'annual crop kilogram weight'. The question was added during discussion with a trial questionnaire interview sample who was an amateur apiarist. The author also discovered that one sample visited was the sole producer of soft fruit canes for supply to other growers, organic and otherwise. Accordingly the variables were added to the questionnaire as an adaptation of questions 58 to 62 section 1 soft fruit. Under this heading, production of soft fruit was recorded in kilograms with monetary value and plants and canes (one producer only) were recorded in thousands of units.

Section 9, questions 94 and 95, request 'precipitation' and 'temperature' details. This data will be useful in further work for benchmark purposes but will not be used in this study.

Section 10, 'Business Detail', is divided into 4 groups of questions. The first group, comprising questions 1 to 7, detail 'capital costs', all of which would be used in the analysis which follows in chapter 6. The second group covers 'wage costs' for 'full' and 'part-time labour' on an annual basis (question 8). The third group of questions, numbers 9 and 10, ask for 'business rate', although in most instances amongst the sample none were payable, and 'insurance' which was an expense for all.

Questions 11 to 15 refer to 'produce input' in terms of 'seed', 'bulbs', 'sets' and 'organic' and 'inorganic fertilizer' costs in monetary terms. Sales income is covered by questions 16 to 29 for each type of produce and open day or course income. Marketing methods in question 30 are framed on a yes/no basis with an opportunity in question 31 to declare income from any other output not covered elsewhere in the questionnaire.

Finally, questions 32 and 33 ask the sample to declare percentage of income derived from any or all of the marketing methods and the percentage of income generated from each market.

5.6 Locating commercial growers for interview

Based upon the pilot questionnaire the author formed an approach as follows.

- Personal interviews require considerable time inputs – at least 40 minutes per respondent.
- Considerable travel within Wales would be required.
- Only one visit would be possible to any one producer; by the nature of their work growers have limited time to spare.
- Excess information can be discarded or omitted from analysis if found irrelevant on the basis that, for example, a sole producer will be the only grower of a specific crop and therefore the single item cannot be considered within the analysis to form benchmarks.

Although, the cost of self-completion questionnaires asking for quantitative data by post, or email, is relatively low, the questionnaires can be distributed quickly, and data collection can be rapid and the method benefits from economies of scale, although many disadvantages also exist. According to Aldridge et al [2001] some of these are, questionnaire length: cumbersome questions that take too long to answer: low response rates: the researcher has little control of context of response – or who fills in the form, the spirit in which answers are given and those people with literacy or mobility problems are less likely to respond. Telephone questionnaires too, are expensive, state Aldridge et al [2001] and present many other disadvantages, such as convenience of call-time. Face-to-face interviews provide comprehensive opportunities, although do have some disadvantages such as time constraints of interviewee and interviewer and, in the experience of the author, the interviewee sometimes wishes to discuss issues not included within the questionnaire. This eventuality can consume time that could and should be devoted to the matter in hand. According to the advantages or disadvantages of face-to-face interviews listed below, as detailed by Aldridge et al [2001], personal interview questionnaire is the most reliable method to obtain the necessary detail required for this study. Aldridge et al [2001] advise their methods of gathering data in a social research context as detailed in Table 5.1.

5.6.1 Sample Selection

At this stage of research there was a need to contact a suitable sample of vegetable food crops producers for interview. Due to the Data Protection Act [1998] the organic registration bodies listed below in Table 5.2 were reluctant to provide any contact details for growers and producers of organic vegetable food crops.

Table 5.1 Face-to-Face Interviews. Pros and Cons.

Advantages – Face to Face Interviews	Disadvantages. Face to Face Interviews
Length of interview schedule Because responses are verbal, it is possible to ask more questions than in a self-completion questionnaire. The appearance of the interview schedule is not relevant to the interviewee.	**Cost** Interviews are costly in money and time.
Complex questions The presence of the interviewer enables complex questions to be explained, if needed, to the interviewee.	**Sample size.** Because of the time and money involved, one interviewer can conduct a limited number of interviews each day. There are no economies of scale.
Question skips. As long as they are clear to the interviewer, question skips raise no problems for the respondent.	**Geographical restrictions.** The cost of travel and time it takes may limit the geographical reach of surveys carried out by interviews.
Open Questions. Since the respondents do not have top write their answers, open questions can be used more freely.	**Time to collect data.** Given that interviewing can be taxing for the interviewer, especially when interviews are not wholly structured, any one researcher can only undertake a few interviews each day – often four is the maximum.
Salience. The use of open questions, and non-verbal cues for the respondent, enables the interviewer to gauge which items are salient to the respondent and which are of no concern.	**Interviewer bias.** Interviewers can introduce bias by offering unauthorised comments on the questions, the research or the interviewee, which can lead the respondent in a particular direction.
Visual aids. Show cards can be used to help respondents frame their answers.	**Interviewer effects.** Personal characteristics of the interviewer-such as age, sex, ethnicity, dress or ascent-can effect the way in which the interviewee responds.
Control over context of response. In contrast to self-completion questionnaires, the researcher has control over who responds to questions and the sequence of questions. By establishing good rapport the researcher can ensure that questions are taken seriously.	**Leading questions.** Even without interviewer bias, leading questions can easily be introduced unwittingly into the less structured part of an interview.
Rapport. The interviewer's success in achieving a good relationship with the respondent will improve the quality of the answers.	**Anonymity.** Although confidentiality can be guaranteed, anonymity clearly cannot.

Source Aldridge, A. and Levine, K. 2001. Surveying the Social World. Principles and Practice in survey research. Box 3.2.

The prospect of searching through telephone directories for the whole of Wales to locate vegetable food crops producers initially appeared a daunting task. The obvious sources to obtain the required information are the organic registration bodies, or the relevant government department responsible for overseeing the process, which at the time was the Department for Environment Food and Rural Affairs.

Table 5.2 Organic Registration Bodies

IOFGA	Irish Organic Farmers and Growers Association.
BDAA	Bio-Dynamic Agricultural Association of Great Britain (Demeter).
OFF	Organic Food Federation.
OFG	Organic Farmers and Growers Ltd.
S A	Soil Association Ltd.
SOPA	Scottish Organic Producers Association.
OTL	Organic Trust Ltd.
CMI	Check Mate International (USoil Association and UK)
FCS	Food Certification Scotland.
UKROFS	United Kingdom Register of Organic Food Standards.

Source Department for Environment Food and Rural Affairs 2002

The Department for Environment Food and Rural Affairs refused co-operation citing, but omitting to state the particular section of the Data Protection Act [1998] and initially the registration bodies refused on the same premise. After much negotiation, and the signing of a confidentiality agreement, two registration bodies, the Soil Association (the largest registration body), relented and provided lists for growers and farmers within

Wales (Appendix 5) and later, Organic Farmers and Growers Ltd, (second largest), cooperated and provided a full list of registered members in Wales (Appendix 6). Additionally, the Wholesome Food Association (as described in chapter 3 Section 3.2.4), the registration body for non-organic growers pledged to use natural growing (as in organic) methodology agreed to cooperate and provided contact details for their membership (Appendix 7). The author is a member of the Wholesome Food Association and access to the list of grower members registered with the Wholesome Food Association presented few problems. The Wholesome Food Association members are small producers with holdings too small, or perhaps with other restraints, that precludes registration with an organic registration body under European Benchmarking Council Regulations (EEC) 2092/91 in accordance with the European Benchmarking directive. However the Wholesome Food Association Newsletter [2005] announced that a £100,000 grant had been obtained from the Department for Environment Food and Rural Affairs by the Wholesome Food Association for them to assist smallholders in the development of local food markets. As the Wholesome Food Association members are aware the Association has lobbied for grants and subsidies to assist affiliated growers not registered with the United Kingdom Register of Organic Food Standards. All three grower's lists supplied lacked telephone numbers and were provided on the basis that confidences and anonymity would be observed. The combined lists contained in excess of 300 names and addresses of farmers and growers from which the author had to find those vegetable food crop producers willing to participate in the project. Telephone numbers were obtained using directory enquiry services, but some growers held 'ex directory numbers', so could not be contacted. Specialist growers of vegetable food crops and kindred produce were extrapolated from the lists and telephoned requesting a personal interview. Some of the telephone calls were prolonged because most of the call recipients sought a summary of the nature of the research and its implications, and in some cases the offer of interview participation was declined. Over a two month period a list of 40 growers willing to participate in the study was compiled. An itinerary for visits to their premises shows diverse locations across Wales from the Vale of Glamorgan, (in the South), to the Island of Anglesey, (in the North) (Appendix 8). Four of the listed growers are not registered as organic and neither do they have membership of the Wholesome Food Association. They tend allotments in the Pontypridd area of South Wales, within walking distance of the University of Glamorgan. Since this study will provide benchmarks for vegetable food crops growing on unused allotment plots and other small vacant land areas, the author included the four, and an allotment gardener from Cardiff. One of the registered growers declined interview on arrival at his premises, but offered to forward answers to the questionnaire by e-mail to the author, which he omitted to do. A total mileage of 1,937 miles was recorded over a period of 13 days involving 87.5 hours of combined travel and interview time. The author drives a small car with an engine capacity of 1398cc and has calculated the CO_2 emissions resulting from the distance travelled as 446kg (981 pounds).

5.7 Conclusion

This chapter has discussed a number of definitions of benchmarking in agriculture and revealed that, as far as this work can ascertain, there has not previously been research to establish benchmarks for vegetable food crops cultivation for the guidance of small producers. Rationale for the establishment of such benchmarking has been discussed and the criteria for the questionnaire design established. An explanation of the need for a pilot questionnaire and a brief description of the preliminary results has been given. The compilation of the grower's questionnaire has been discussed in detail and reasons for questions being posed which may be tangential to this particular research explored. Chapter 6 will describe in detail the analysis of the data from the personal interview questionnaire.

CHAPTER 6

RESULTS

Chapter 6: Results

6.1 Introduction

This chapter discusses how the sample interviewees were chosen and seen personally by the author. Contact by telephone using lists of members provided by the Soil Association, Wholesome Food Association and Organic Farmers and Growers Ltd identified Growers available and willing to participate in the survey. These lists, although extensive, revealed that there were relatively few vegetable food crop Growers from which to choose from. (Appendices 5, 6, and 7 lists registered Grower/farmers). The registered Grower lists comprise all sections of the agricultural industry including dairy, beef, pork, poultry, fruit and vegetable producers, processors and packers. All agriculturists within the survey practice a mixture of some or all the above disciplines. However, although specialist husbandry practitioners were precluded some of the selected Growers are often specialist tomato or cucumber Growers; others grow carrots and some just onions and potatoes or perhaps salad. On one holding swede crop is grown for cattle consumption. On another holding which is a registered charity, some income is derived from courses. Vegetable food crop and herb production there is minimal although the remit of the charitable project includes viable growing of both. There are no two Growers within this study sharing any real similarity of holding size, production methodology or crop types. The four allotment holder interviewees in this survey, samples 5, 6, 7 and 8, occupied neighbouring plots of 100 feet by 30 feet (30.48 metres by 9.14 metres) on a Pontypridd site in South Wales; even as neighbours their crop production methodology crop types and harvest quantities differed greatly. The fifth allotment holder, sample 26, gardened on a central Cardiff allotment site. In all five cases the crop types grown were those the allotment holders favoured for their own family or personal consumption. These five samples do not practice organic methods of cultivation but at the same time avoid chemical application to their plots whenever possible.

Other interviewees for the on-site research for this project are farmers, small holders and market gardeners. Smallholdings and market gardens are land plots of diverse sizes usually with a dwelling house and outbuildings, where horticulture is practiced and the produce sold in multifarious ways. Some crops are sold on the 'farm gate' principle meaning that the crops grown are sold directly to any person or persons calling at the Growers holding. Other Growers distribute their produce through small retail outlets in the immediate locality such as town centre markets, shops, restaurants, hotels and cafes. As an example of diversity, a Hampshire friend (not included in this study) of the author grows soft fruit, vegetables, flowers and eggs to sell in his own retail shop, whilst another acquaintance in the same area with a similar size holding supplies local greengrocers with vegetable food crops and flowers only. Neither is registered as organic, but both raise their crops by organic methods. Their incomes differ in that the Grower distributing his produce through his own retail outlet has a considerably higher gross income than the producer selling his crops to retailers at a lower price. However, the first Grower incurs additional staff and premises costs. Without empirical research it would be difficult to establish which Grower is the most efficient and profitable, but on a subjective assessment they are probably comparable. This study is directed to the understanding of such anomalies and development of a method of analysing the problem to provide satisfactory benchmarking to ensure both Growers could attain sustainable profitable productivity for their efforts. By using benchmarking procedures, each may attain better results by using inputs and methods adopted by the other or others within the analysis. The Hampshire example is discussed to avoid citing the example of any of the Welsh participants in the survey, which may influence assessment of the final analysis of this work. Table 6.1 shows the 40 sample Growers output by crop type to illustrate output differentials encountered during the analysis.

6.2. The extent of data.

Data gained from the Welsh study interviews is diverse and often more extreme than the Hampshire example. Section 5.2 chapter 5 describes the compilation of the questionnaire designed to cover as many aspects and eventualities of horticulture as possible. On completion of the first 12 questionnaires application of the variables to the Pinpoint answer system revealed the software's inability to handle so much information. The data was initially transferred to Microsoft Excel spreadsheets and then to the Statistical Package for the Social Sciences Software. The Social Sciences software available at the University of Glamorgan restricts the application of variables in excess of 1500 to the programme; therefore an alternative was sought for a trial analysis of the data collected, which had 1570 variables per questionnaire. The final number of variables used in the complete survey was 1657.

There are different ways to assess a process and all will provide a different perspective of performance. This study requires objective and comparative measures of performance to identify the most efficient Growers within a group and thus identify peer

Growers against those under-performing. The question arises about the possibility of identifying "the best of the best" to compare with other producers and that problem is discussed later in this chapter. However, theoretically the under-performers could be influenced by the results to emulate their efficient peers in order to attain the same or

Table 6.1 Growers output by type

Grower	Root Veg	Arial Veg	Flo Veg	Leaf Veg	Arial Fruit	Bul Veg	Herbs	Flowers	Plants	Soft Fruit	Coppice	Courses	Fruit Canes
1	X	X	X	X	X	X	X			X		X	
2	X	X	X	X		X				X		X	
3	X	X	X	X		X	X						
4	X					X							
5	X	X	X	X		X	X	X		X			
6	X	X	X	X		X	X	X					
7	X	X	X	X		X							
8	X	X	X	X	X	X	X			X			
9	X			X									
10	X			X									
11	X	X	X	X	X	X	X			X			
12	X	X					X			X			
13	X	X		X		X		X					
14	X												
15	X	X	X	X	X	X	X			X	X		
16	X	X								X			
17	X	X	X	X	X				X				
18	X	X		X	X	X	X	X					
19	X	X	X	X	X	X		X					
20	X			X	X								
21			X	X	X								
22			X	X	X								
23	X	X	X	X	X		X						
24	X	X	X	X	X		X	X	X	X			
25	X	X	X	X	X			X		X			
26	X	X					X	X		X			
27	X	X	X	X	X	X	X	X	X	X			
28													X
29													
30	X	X	X	X		X	X						
31	X	X	X	X	X	X			X	X			
32		X	X	X		X	X						
33	X												
34	X	X		X		X				X			
35	X	X	X	X		X	X						
36	X	X		X		X	X			X	X	X	
37	X	X	X	X	X	X		X		X			
38	X	X	X	X	X	X			X	X			
39	X	X	X	X		X	X	X	X	X			
40	X	X	X	X	X	X	X			X			

similar standards. Whichever method is used to determine the most efficient producers, the most difficult part of the efficiency evaluation could be the decision: 'which input and output data should be included'. Additionally, there could be confusion in distinguishing the differentials between input and output. For example, some Growers save seed from crops to sow the following year; each Grower interviewed in the survey has specified the cash value of seed saved. If they save seed – should this be classed as an output or an input – or, in some way, both? For the purpose of the analysis it has been decided that seed saved is an input: therefore seed save and seed purchase have been combined for the analysis.

Other anomalies exist but are not dealt with in the analysis here. These include the use of composts produced from waste crops or green manures from grown clovers and perhaps lupins, which could be described as inputs or outputs. To grow either requires seed and labour input, but there is no monetary value placed on the resultant green manure crop in this survey. Do Growers who use these fertilisation methods have an advantage over those who purchase fertilizers (chemical or natural) or are they at a disadvantage because of the labour cost? Bought fertilizer as an input has a labour requirement for application but does not incur costs of manufacture at Grower user point. Composting and green manure growing on Growers land is labour intensive and requires a production area that could be used for profitable vegetable food crop production or, indeed, any other horticultural productivity. For example, few of the sample Growers keep chicken, duck, geese, rabbit or bees. All could be profitable enterprises; honey probably the most highly valued in monetary terms. As an aside we should always be mindful that without bees there would be no food crops.

During interview Grower 31 expressed an interest in using sounds and vibrations to increase crop yield. He stated that on two separate plots of his land the plot influenced by sight and sound produced considerably more crops than the other. Also, his method of pest control for slugs and snails is the use of sheep's wool and his woodland is subjected to 'tree hugging'. None of these experimental or ethereal processes are included in the questionnaire for the following reasons.

- Most of the interviews had been completed by this time and therefore it was too late to update the survey questions, and too costly for a second visit to those already interviewed.

- No other interviewee had mentioned such practices.

- Additionally, during the literature research, no such processes were found to have any scientific basis, although perhaps an open mind should be applied to such phenomenon.

6.3 Suitable software for the analysis

Frontier Analyst Software, able to deal with multiple decision making units related to different resources activities and environmental factors was adopted for the analysis due to its ability to process numerous variables. For example, Growers within the sample cultivate different varieties of crops. No two Growers have the same inputs and outputs but a sample deemed as an inefficient producer growing potatoes can be compared with an efficient producer also growing potatoes and his other outputs, perhaps apples can be compared to another or other sample producer not growing potatoes. Comparing like for like also means that a sample that's only output is tomatoes can be compared to a Grower producing multifarious crops including tomatoes. Other software analysis systems including Statistical Package for the Social Sciences Software system were tested and revealed an inability to deal with the comprehensive data within the 1657 variables contained in the questionnaire.

However, Banxia Frontier Analyst 'Data Envelopment Analyst' trial software available at the University of Glamorgan restricts analysis to twelve cases and endless variables and accordingly initial trial analysis was performed within that parameter.

The questionnaire recorded vegetable food crop production (outputs) in terms of weight (kilograms) and monetary value in terms of £'s sterling. Costs (inputs) were recorded in the same way. Also, in the instance of land areas for example, numeric variables failed to provide accurate appraisal. A process of data re-coding was therefore considered necessary before analysis and numeric variable ratio values were substituted for land areas. There would be little point in adding together two different crops by weight to establish an output value against cash input. Adding the cash value of each crop type will give a true indication of total crop production without complication. Other variables can also only be recognised in cash value terms. As an example there may be a programme of courses or visit days conducted on some holdings. Similarly variables for part-time and full-time employees recorded in hourly and cash terms need to be recognised as cash value input only – it is accepted that hours worked by full or part-time staff attain equal productivity levels. In the final analysis of the benefits of local production the monetary gain will no doubt take precedence although product volume will also be audited. For the benefit of participants in small growing enterprises, benchmarks will need to indicate rewards for work input in cash terms relative to the national minimum wage too. Although, horticulture brings reward for many by providing healthy exercise and fresh healthy food and relaxation, there may be others whose sole need is financial reward for physical labour. If physical work is financially rewarded and the other benefits accrue, perhaps without realisation of the participants, then some primary objectives will have been attained.

Following re-coding of some variables from numeric to ratio, the 1657 variables were exported from Statistical Package for the Social Sciences Software System to Excel and then to Banxia Frontier Analyst software for Data Envelopment Analysis

6.4 Testing data envelopment analysis suitability

Apart from the inability of other software to cope with the analysis required for this thesis Data Envelopment Analysis has been selected to pursue the objective of this research partly because Hussain et al [2000] tells us that 'Data Envelopment Analysis identifies peers for inefficient units'. A peer is a unit found to be efficient with a similar combination of weights as that of an inefficient unit. Where two or more of these efficient units act as peers for an inefficient unit, they provide a "peer group" for the inefficient unit [Hussain et al 2000]. The peer group is also known as the reference set of an inefficient unit. The characteristics of the units in the reference set provide the targets for the inefficient units to work towards. The reference set of each inefficient unit contains the efficient units, which have the most similar input/output orientation to the inefficient unit; they should therefore provide examples of good operating practice for the inefficient unit to emulate. To ensure that Data Envelopment Analysis was suitable for the author's purpose; to determine the efficiency of all sampled Growers and establish a method to explain and prove the benchmark theory for vegetable food crop production the author decided on a trial analysis using the Banxia Frontier Analysis. This would demonstrate the ability of the software to deal with numerous variables without limitation and establish competence in use of the selected software.

6.5 Trial analysis

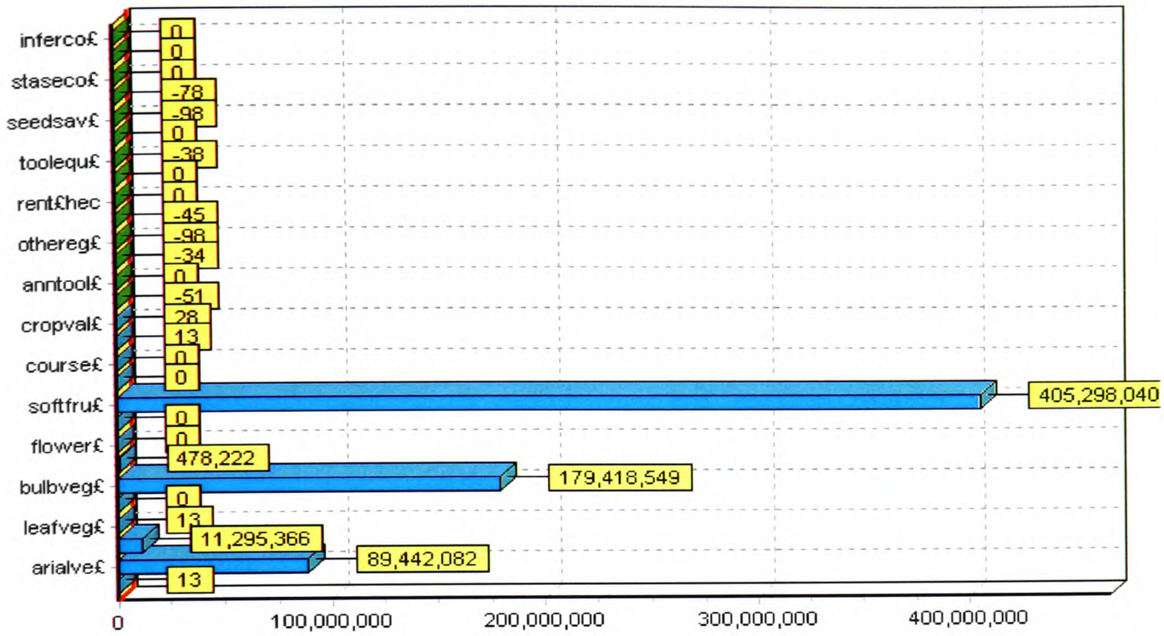
Results of the trial analysis of questionnaires using Data Envelopment Analysis for 11 of the 12 sample cases (shown in Table 6.2) surveyed demonstrate that, after comparing like with like, six are of equal efficiency and therefore rated as 100% output efficient for the four input and eight output variables selected for analysis from the 1570 available. The twelfth sample Grower 10 was initially disregarded through lack of variety in variables - the producer was not cultivating such a comprehensive range of vegetable food crops as the other Growers in the sample, and those that were cultivated were not amongst the sample selected for analysis in this research project. Also, the entire vegetable food crop production of Grower 10 was used mainly as cattle fodder and not for human consumption. However, when Grower 10 was included 78.70% efficiency was evident when comparison was included. Grower 4 was, at the time of interview in organic conversion and was cultivating and harvesting garlic and potatoes;– crops which were a minor part of the other 11 Grower's crop production. Within these six cases showing 100% efficiency there are variables showing up as inefficient against the same elements within other cases in the peer group, although all six are within the boundary of 100% efficiency on an overall basis. The remaining five Growers showed various efficiency levels shown in Table 6.2.

If Grower 10 remains in this trial analysis, the other scores do not alter, but Grower 10's score remains at 78.70 % efficiency, producing leaf and root vegetable food crops. This illustrates that Data Envelopment Analysis compares like for like, regarding the crop production of the peer group as seen in column 4 of Table 6.2. Frontier Analyst produces potential improvement graphs to illustrate in which areas the inefficient units need to improve overall efficiency in percentage terms. Figure 6.1 shows Grower 10's potential in the trial analysis of Growers 1 to 12. In this case Grower 10 scores 78.70% efficiency. Later analysis includes all 40 of the sample and shows Grower 10 with 88.70% efficiency rating.

Table 6.2 Trial analysis Growers' efficiency levels

Grower	Produce Types	Efficiency Rating	Efficiency Rating when including G10
1	Mixed vegetable food crops	100 %	100 %
2	Compost and vegetable food crops	100 %	100 %
3	Mixed vegetable food crops	13.90 %	13.90 %
4	Garlic and Potatoes	100 %	100 %
5	Mixed vegetable food crops (Allotment)	100 %	100 %
6	Mixed vegetable food crops (Allotment)	87.80 %	87.80 %
7	Mixed vegetable food crops s (Allotment)	56.27 %	56.27 %
8	Mixed vegetable food crops (Allotment)	63.67 %	63.67 %
9	vegetable food crops and Soft Fruit	100 %	100 %
10	Leaf Vegetables and Dairy cattle	0	78.70 %
11	Mixed vegetable food crops, Soft Fruit and Plants	100 %	100 %
12	Mixed vegetable food crops	12.03 %	12.03 %

Figure 6.1: Potential improvement for Grower 10 trial analysis



Key to Figure 6.1 (Y Axis)

inferco £	Inorganic fertilizer costs £ sterling per year
staseco £	Standard seed, plant, set &, bulb costs £ sterling per year
seedsave £	Seed save value £ sterling per year
toolequ £	Initial Tool & Equipment requirement £ sterling
rent £ hec	Rental per hectare per year £ sterling
othereg £	Registration costs non-organic Growers £ sterling per year
anntool £	Tool and Equipment maintenance & replacement costs £ sterling per year
cropval £	Total crop value £ sterling per year
courses £	Total course income £ sterling per year
softfru £	Soft fruit crop value £ sterling for year
flowers £	Flower crop value £ sterling for year
bulbveg £	Bulbous vegetable crop value £ sterling for year
leafveg £	Leaf vegetable crop value £ sterling for year
arialve £	Arial vegetable crop value £ sterling for year

The X Axis (bottom) of Figure 6.1 refers to percentage points.

6.6 Data standard

It is noted that two of the sample Growers (Grower 2 and Grower 11) keep accurate records of planting, harvesting and cash values of crop production. The variables obtained from other producers were from memory, or irregular recording; which raises the question as to whether the cases found more efficient in the Data Envelopment Analysis are actually more efficient, or whether it is a property of the data. As Turner [2004] observes, "Data Envelopment Analysis is a sophisticated mathematical technique which involves optimising various expressions, and this can only be achieved with confidence if the data meets high standards of reliability and validity". Even if the data is superficial, designing the benchmarks will still use those Growers in this survey who showed themselves on the analysis to be 100% efficient regardless of their failure to keep accurate records.

The trial analysis result was obtained from the use of four variables as inputs because the Frontier Analyst demonstration software precludes free use of a greater number than 12 variables of inputs and outputs. The four inputs and eight outputs were selected solely for trial purposes based on their commonality between the sample Growers used and are illustrated in Table 6.3.

It is intended that benchmarks sought in this study will provide guidance for various groups using small land plots. These groups may comprise school children, community groups and other parties unfamiliar with horticultural practices. On that basis financial benefits and crop quantities could be as important as education and social cohesion as well as other factors. Accordingly the monetary value of outputs will probably be the most important factor. It may be that schools involved in a small vegetable food crop production enterprise would purchase produce for internal school canteen use or a community group may want to retail produce for community benefit. Consequently the benchmarks will need to include all inputs and outputs in cash as well as crop values and not on the sole basis of efficiency. It should be noted that present legislation prevents the sale of allotment produce, although change has been discussed since 1998 but nothing has yet been implemented [Her Majesty's Government 1998].

Table 6.3 Inputs and outputs for trial analysis

Inputs	
Area (Hectares)	Full time employees (cash value)
Part time employees (cash value),	Courses (annual gross cash income).
Outputs	
Root vegetable (crop cash value),	Arial vegetables (crop cash value),
Flowering vegetables (crop cash value),	Leaf vegetables (crop cash value),
Arial fruit (crop cash value),	Bulbous vegetables (crop cash value),
Herbs (crop cash value),	Soft fruit (crop cash value)

An accepted simplistic measure of efficiency benchmarking in business and industry is stated by Hussain et al [2000] as:

$$\text{Efficiency} . \quad \frac{\text{Weighted sum of Outputs}}{\text{Weighted sum of Inputs}}$$

However, Data Envelopment Analysis is designed to overcome the problems associated with such a simple formula in that. 'Output' and 'Input' in all industries will not always be expressed in the same units, which apply to horticultural practice. Data Envelopment

Analysis will benchmark all units against the most efficient units within the survey on their individual performances within each element.

To establish benchmarks for production and distribution for vegetable growing by individual Growers, allotment societies, co-operatives and community projects, research is based on the application of Data Envelopment Analysis. Formulated from 1657 variables of input and output data related to different resources, activities and environmental factors, the benchmark will be the most efficient unit which can be constructed from elements of the most efficient producers within the personal interview survey results. However, in the case of small Growers this is inadequate because inputs and outputs are related to diverse factors by difference in amounts of resources. In the case of agricultural practice, a formula for relative efficiency incorporating multiple inputs and outputs is required to develop and determine efficient measures to maximise production.

6.7 The analysis of 28 variables

Following the trial analysis homogenous variables relative to all 40 Growers sampled, as illustrated in Table 6.1 were selected to establish the most efficient producers with regard to crop cash value. The question of deciding the best of the producers to be used as a standard arises. Is it possible for the Data Envelopment Analysis system to establish which producers are the most efficient from the data available? Further, can the results be subjected to a simplistic interpretation by inexperienced new producers as benchmarks for vegetable food crop production? From the trial analysis it is not clear that there is a simple answer and the provision of a method to provide the benchmarks required may not materialise. However, at this stage it was decided that to establish the reliability of the chosen analytical method the full analysis should take place.

The 28 variables, 14 controlled inputs and 14 outputs, were selected for their immediate apparent relevance and are shown in Table 6.4. It was decided that variables of seemingly less importance, including, for example, 'insurance premiums', 'temperature', 'land aspect', definitive types of 'pest control' and 'fertilization of soil', all of which could be of significance within the parameters of benchmarking, must be examined later as a separate comprehensive research programme. It may become apparent later in the analysis that some of the variants not analysed could impact considerably on results. For example the land aspect is often fundamental to some crops and not others. It could be that Growers with a lower efficiency rating may not have given sufficient consideration to land aspect through perhaps lack of experience or commercial pressure to grow vegetable food crops not suited to the particular aspect of his holding.

Table 6.4 Inputs and outputs for detailed analysis

Inputs	
Number of Hectares.	Registration costs.
Other Registration Costs.	Freehold Purchase Cost.
Annual Rent Per Hectare.	Annual Allotment Rent.
Initial Tool/Equipment Costing.	Annual Tool Replacement/Maintenance.
Annual Full & Part Time Wages.	Annual Seed Save.
Annual Organic Seed Purchase Cost.	Annual Standard Seed Purchase Cost.
Annual Organic Fertilizer Cost.	Annual Inorganic Fertilizer Cost.
Outputs	
Annual Root Vegetable Sales.	Annual Arial Vegetable Sales.
Annual Flowering Vegetable Sales.	Annual Leaf Vegetable Sales.
Annual Arial Fruit Sales.	Annual Bulbous Vegetable Sales.

Annual Herb Sales.	Annual Flower Sales.
Annual Plant Sales	Annual Soft Fruit Sales.
Annual coppice Sales.	Annual course Income.
Annual Home Consumption of Crop.	Total Annual Value All Crops.

The term 'intangible input' may be relevant to the practice of 'seed save' because the seed saved is an output from the previous crop, as discussed above. For the purpose of this analysis the saving from 'seed save' appears in most instances to be minimal. Seed saved and seed spend will initially be regarded as input during the analysis and will be added together. In another study 'seed saved' should be recognised as an output as opposed to an input to identify the impact of the seed saved element within the benchmark theory. The anomaly of differential between input and output classification with regard to 'seed save' could impact profitability considerably in some instances if the question of how much the saved seed could be valued in monetary terms as output. Similarly, where applicable, each Grower's crop value should later be examined with regard to crops from seed save and crops from seed purchase. The instances of course provision could also be classed as intangible because, although the income for such activity is, on the face of it, an input, what is the gain in output for participants.

6.7.1 Detailed analysis

For the detailed analysis the inputs and outputs illustrated in Table 6.4 were selected because of their apparent significance as primary elements for the efficient production of vegetable food crops. Sustainability needs to be economically viable too and the proposed benchmarks will be designed with that in mind. Table 6.1 shows numbered Growers and the relevant output data for each of them to give holistic overview of the analysis below.

6.7.2 Efficiency

The overall efficiency of the sample group of 40 Growers relative to the inputs and outputs decided by Data Envelopment Analysis detailed in Table 6.3 is illustrated in Figure 6.2. Each sample Grower has efficiency score between zero (0.00%) and 100 (100.00%). All 40 sample Growers, with the exception of Grower's 10, 25 and 29, are shown to have 100.00% efficiency. Grower 29 is shown as having a 0.00% efficiency rating, because no data was obtained from him with the exception of his organic registration fee and three hectare land input. Grower 10 is shown as having an 88% efficiency rating as he is an organic dairy farmer growing organic root vegetables as cattle feed: Grower 25 has efficiency rating of 88.70%.

Grower 10 has under cultivation for vegetable food crops approximately three times the land area of Grower 29 (excluded from the analysis) and three times that of Grower 25. Grower 25 shows 88.04% efficiency and produces vegetable food crops all of which are for human consumption but the value of his produce is only 2.99% of Grower 10's in monetary terms. Grower 25 sells seven of the vegetable food crop groups comprising 23 varieties of high value produce, but Grower 10 sells only one of the two varieties sold by Grower 25. Grower10's swede crop feeds his dairy cattle and his second product is cabbage, sold through the wholesale market. Different produce carries different prices in the market and Grower 10s is valued at the same monetary output values, as all 40 sampled Growers (excepting Grower 29). Tables 6.5a to 65h show valuation given to each product per kilogramme from which it can be seen that the two varieties of vegetable food crops grown by Grower 10 carry a higher value per kilogramme than some of Grower 25's vegetable food crops and some a lower value. For the questionnaire, and the analysis, each vegetable food crop is allocated to form groups and defines value per kilogram as shown Tables 6.5a to Table 6.5h.

Figure 6.2 Efficiency scores for all Growers in the sample group

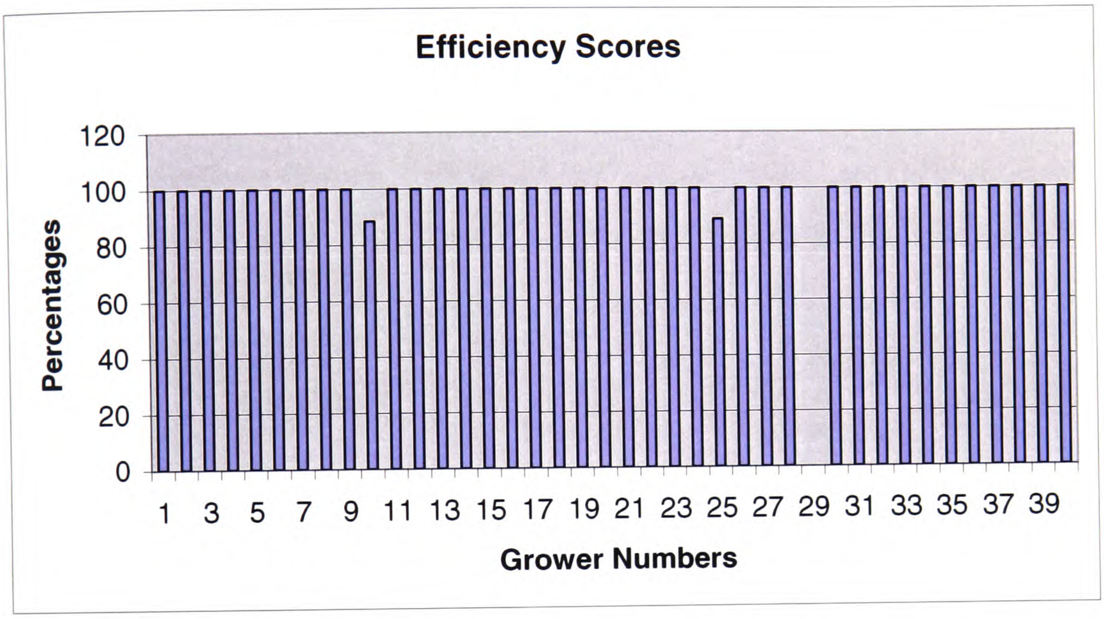


Table 6.5a Produce valuation

Root Vegetables	
Crop	Kilo Value
Celeriac	£1.80
Potato	.65
Turnip	£1.32
Beetroot	£1.25
Carrot	£1.20
Swede	.87
Parsnip	£1.75
Celery	£2.00
Radish	£2.31

Arial Vegetables	
Crop	Kilo Value
Runner Beans	£1.65
Broad Beans	£1.61
Peas	£1.73
French Beans	£3.09

Table 6.5b Produce Valuation

Flowering Vegetables	
Crop	Kilo Value
Cauliflower	£ 2.00
Squash	£ 1.53
Marrow	£ 1.30
Asparagus	£11.00
Aubergine	£ 3.52
Cucumber	£ 2.00
Pumpkin	£ 1.20
Courgette	£ 2.41

Leaf Vegetables	
Crop	Kilo Value
Lettuce	£4.25
Spinach	£3.57
Cabbage	£1.46
Broccoli	£2.20
Sprouts	£1.76
Kale	£1.76

Table 6.5c Produce Valuations

Arial Fruit	
Crop	Kilo Value
Eating Apples	£1.87
Cooking apples	£3.64
Pears	£1.98
Plums	£1.80
Damsons	£1.95
Cherries	£1.20

Bulbous Vegetables	
Crop	Kilo Value
White Onions	£1.10
Red Onions	£1.55
Spring Onions	£3.15
Leeks	£1.76
Garlic	£6.60
Shallots	£2.00

Table 6.5d Produce Valuations

Herbs	
Crop	Kilo Value
Thyme	£10.00
Parsley	£10.00
Rosemary	£10.00
Coriander	£10.00
Chives	£10.00
Sage	£10.00
Other Herbs	£10.00

Flowers	
Crop	Bunch Value
Daffodils	£1.50
Carnations	£2.50
Pinks	£2.50
Tulips	£2.50
Dry	£3.50
Others	£33.50

Table 6.5e Produce Valuations

Bedding Plants	
Crop	Kilo Value
Assorted	£1.55
House Plants	£4.00
Other (By Tray)	50
Assorted	£1.55

Soft Fruit	
Crop	Bunch Value
Raspberries	£10.40
Currents	£6.00
Strawberries	£4.00
Gooseberries	£4.00
Rhubarb	£1.33
Tomatoes	£2.42

Table 6.5f Produce Valuations

Soft Fruit Canes	
Crop	Value Each
Various	13 Pence
Various	36 Pence

Crafts/Fuels	
Crop	Kilo Value
Willow	50 Pence Fuel
Willow	£5.00 + Craft

Table 6.5g Produce Valuations

Vines	
Crop	Kilo Value
Grapes	£3.50

Apiary	
Crop	Kilo Value
Honey	£5.50 kilo

Table 6.5h Produce Valuations

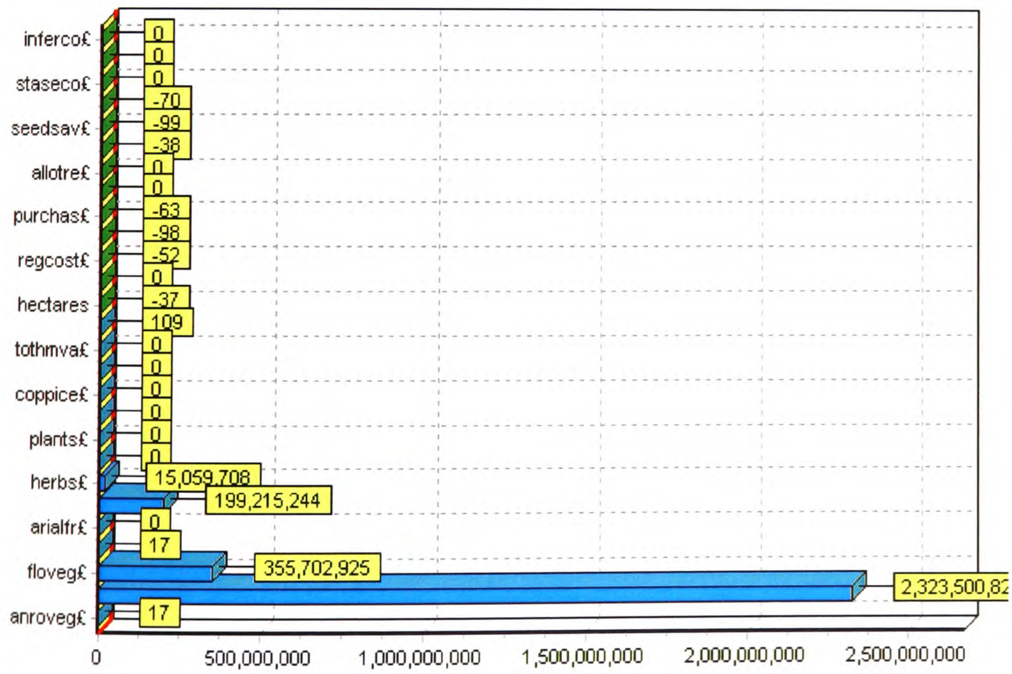
Courses	Income
Various	Annual

Grower 10 uses a total seed value (saved and bought) equating to 909.00% more than Grower 25. Grower 10 has greater wage input, but other inputs are almost identical to Grower 25. So, on the economies of scale principle, the smaller holding, Grower 25 is, in this case, only 0.40% more efficient than the larger enterprise. However, by removing the full-time and part-time wage variable of all Growers within the sample group, a marked change in efficiency occurs relative to Grower 10 and Grower 25; Grower 10's drops to 84.78% and Grower 25's to 36.50%.

6.7.3 Improvement potential

The efficiency scores and potentials for improvement by Growers 10 and 25 when compared to the whole sample group are shown in Figure 6.3 Potential Improvement Graph below. The result, as illustrated by Data Envelopment Analysis, requires some discussion as to it's validity in deciding on a benchmark structure because of difficulties of simplistic interpretation that may be encountered.

Figure 6.3 Potential Improvement Graph for Grower 10 full analysis.



6.7.4 Grower differentials

Further discussion of efficiency highlights differentials which may have an influence over improvements to be decided by following benchmarks. Grower 25 has no wage input at all as the enterprise is a husband and wife partnership. Albeit, that there must be some cash and produce extraction from the business for personal living expenses. Growers 2, 10 and 25 have not declared consumption of produce from their holdings although it could be assumed that they do consume their own produce. However, to add such subjective data to data already discussed above could be detrimental to the analysis.

Grower 28 declares a seed save element of £4,000.00 per year, plus a £22,000.00 seed spend, which equates to a total seed input of £26,000.00 of which the seed save is 15.38%. The sole output in this instance consists entirely of plants for supply to organic and non-organic Growers of soft fruits. Grower 18 declares the sum of £600.00 for seed save and standard seed purchase of £200.00 to produce high value crops on a rented council holding; 70% of which is sold direct to a wholesaler. But a seed save of £500.00 by Grower 10 is in addition to the purchase of seeds to the value of £3,500.00 which equates to 12.5% of total seed use. Grower 10 is producing two root crops, potato and swede to feed his organic cattle and a leaf vegetable crop cabbage sold directly into the wholesale market. On another extreme Grower 36 saved seed to the value of £200.00, and purchased seeds to the value of £500.00 which equates to 28% of total seed usage. The produce from this holding consists of multifarious crops, which are lettuce, spinach, kale, beetroot, carrot, radish, broad beans, white and red onions, garlic, parsley, raspberries, currents (mixed), rhubarb and tomato: all sold mainly on a retail basis in farmers markets. Depending upon other factors, such as fertilizer, land aspect and drainage for example, seed save could be making his operation more profitable. A study of these factors and all other variables available could perhaps indicate more efficiency: time constraints preclude such analysis for this thesis.

6.7.4.1 Rented land producers

There are five allotment gardeners, Growers 5, 6, 7, 8 and 26 included in the sample and three commercial producers (Growers 1, 18 and 38) who occupy leasehold land at low rental. Growers 5, 6, 7 and 8 occupy allotments on the same site within the Pontypridd Trefforest area in South Wales. Rental to the local town council is £5.00 per annum for plots 30.48 metres by 9.14 metres. Grower 26 rents allotment space of the same size in the centre of Cardiff for £20.00 per annum. Of the sample commercial Growers using rented land. Grower 1 cultivates two hectares rented privately for £120.00 per hectare per annum. Grower 1's produces all categories of leaf vegetables; all root vegetables excluding celery and parsnip; all arial vegetables; flowering vegetables excluding cauliflower, asparagus, aubergine and pumpkin. Grower 1 also produces eating apples and cherries on a small scale and bulbous vegetables excluding spring onions and shallots. Grower 1's only soft fruit products are tomatoes and all vegetable food crops are sold by boxes, farmers markets, local hotels and restaurants and at farm gate. The turnover is £10,194.00 annually, but includes a minimal £80.00 for courses. The only other Growers supplying courses are Growers 2 and 36. Grower 2 runs composting courses on a small scale to produce £100.00 annually. Grower 36 is a charitable organisation and courses form a major part of its activities, producing annual income of £50,000.00 but their vegetable food crop value is minimal at £2,186.00. Grower 18 pays annual rental of £370.00 per hectare for seven hectares. Grower 18's crop comprises all groups except arial fruit, plants and coppice. His produce is distributed through farmers markets, box schemes, farm gate, local restaurants and wholesalers. Grower 38, the largest holding on 100 hectares of rented land attains annual turnover of £465,390.00 selling all grown vegetable food crops from his own farm gate. Grower 38 also has one hectare devoted to organic production and the monetary value of produce from that could not be extrapolated from the total turnover during the questionnaire interview, because the Grower had not kept separate records – his declared turnover was as the sample groups highest. Grower 14 an organic producer with annual turnover of £164,000.00 only produces root vegetables (potatoes carrots and swede on his own farm. He distributes through wholesalers and supermarkets and has the second highest turnover in the sample group. The five allotment holdings are used for pleasure gardening to help feed the cultivator and family although there is exchange of produce with other allotment holders which was difficult to quantify during interview and has not been included as input or output relative to the participating exchangers of produce. Certainly none of the five has a wage consideration within their input data and their various costs differ considerably from those of commercial operatives within the vegetable growing peer group of 40. The rent paying producers differ considerably in that one has a low turnover and inputs and the other is a large organisation with high insurance and wage commitments. The allotment gardeners produce has been valued in the same way as all Growers within the sample group. Data Envelopment Analysis for the overall efficiency for the five allotment gardeners within the peer group shows all as 100% efficient. The removal of rent and wage input does not change the 100% efficiency rating of the allotment holders, although efficiency rating of other Growers is changed. This is because there are no wages as inputs for allotments and the rent is minimal and exclusive to allotments only with the exception of Growers 1, 18 and 38 who grow commercially on rented land and Grower 26 whose allotment rent is unusually high at four times that of allotment plots cultivated by Growers 5, 6, 7 and 8.

6.7.4.2 Rent and wage variables removal from analysis

Whereas sample Growers 1 to 40 excluding Grower 10 and Grower 25 are rated by Data Envelopment Analysis at 100% efficiency in the overall analysis, rent and wage removal from all samples in the analysis does not reduce their efficiency but Growers 10, 25 and 29 show some insignificant change. Firstly Grower 10 showed efficiency reduction from 88% to 84.78% with wage removal but increased to 84.94% with wage and rent removal combined. If Grower 29 is removed from the analysis with wages Grower 10 still shows efficiency of 84.78%, but increases efficiency to 84.94% if rent is removed too.

Grower 25's 88.70% efficiency rating in overall analysis fell to 36.50% on removal of wages and remained at that level after rent removal too. Removing Grower 29 and wages allows Grower 25 to stay 36.50% efficient and taking the rent variable out too makes no difference. Wage and rent variables removal show no alteration of efficiency rating for Growers 1, 18 and 38 (the three rent paying commercial producers). However, if leasehold rent is removed as an input, keeping in mind that the Growers 1, 18 and 38 pay leasehold rent (all others within the peer group of 40 are freeholders with the exception of the allotment gardeners). Growers 1, 18 and 38 still remain 100% efficient.

6.7.4.3 Grower exclusion

At this stage in the analysis it was decided to remove Grower 29 because there are no outputs from just two inputs, and therefore, as seen above Grower 29 is not compatible to the other sample Grower's results. Grower 29 showed 56.72% efficiency rating in overall analysis. Removal of wages and rent increased his efficiency to 79.80% whereas sole removal of wages showed 38.63%: not an anomaly in the Data Envelopment Analysis system but the result of comparing like with like just on the two inputs Grower 29 has. Growers 10 and 25 are less than 100% efficient overall at 88.46% and 88.70% respectively: just as they were before Grower 29 was removed. Data Envelopment Analysis compares like with like; if Grower 29 is missing from the analysis, all other samples will be reviewed with their peers on that like for like basis.

6.7.4.4. More differentials

Growers 10 and 25 differ considerably in that Grower 10 has three times the land area of Grower 25 and almost half the annual tool costs but rower 25 has around half the organic registration fees and totally escapes other registration fees of £700.00, which Grower 10 has to pay. Land purchase costs are identical for Growers 10 and 25 and there are no further outgoings in respect of land tenure. However, initial tool and equipment costs for both are identical but there is a great differential within wage costs; Grower 25 pays no wage costs for the labour of himself and his wife, whereas Grower 10 pays £15,000.00 per annum. The research does not reveal living expenses or wage costs for the Growers personally except to record the monetary value of their own individual vegetable food crop consumption.

Total seed costs for Grower 10 are ten times that for Grower 25 but the output for Grower 10 is approximately 33 times that of Grower 25. At a glance it would seem that if seed costs for Grower 10 were three times those of Grower 25 the output from Grower 10 would equate to three times that of Grower 25 because three times the land area is used for growing. This subjective appraisal is far from the expected objective analysis of Data Envelopment Analysis which takes numerous other variables into consideration including produce not grown by Grower 10 whose output is valued on the same cash basis but used solely as animal feed and not sold for human consumption. The aim of this research is to employ Data Envelopment Analysis as a means to establish objective data as benchmarks for vegetable food crop cultivation for human consumption.

6.7.4 5 Determination of benchmark criteria

The determination of benchmarks requires an initial overall efficiency appraisal. A scores report was prepared by Data Envelopment Analysis using the data sets of input and output variables detailed in Table 6.4. The scores report for all Growers in Table 6.8 shows that Growers 10 and 25 are rated below the 100% scores of the other 37 Growers remaining in the survey (after removal of Grower 29 shown as 0.00 %) at 88.46% and 88.70% efficient respectively. Firstly Grower 10 is to be compared with all 37 Growers to establish those elements of input and output which particularly affect Grower 10's rating. Keep in mind that all variables available for all producers are not included in the analysis; only those detailed Table 6.5 selected as being the most important in the author's estimation. Input minimisation rating for Grower 10 needs to be addressed relative to the maintenance of present output levels and also with the present inputs, to establish what level of output could be achieved for 100% efficiency parity with Grower 10's peers. Figures 6.1 and 6.2 show the percentage change in output or input required by Grower 10 to ensure it has the same 100% efficiency bracket as its peers. The data in Figure 6.1 shows potential on the basis of minimising inputs to produce the same outputs. The data in Figure 6.2 shows potential for maximising outputs given the current inputs. Figure 6.1 shows Grower 10 to have an improvement potential dependant upon reducing all of the fourteen inputs. As with Grower 10, Grower 25 has a below 100% efficiency rating and shows similar potential improvement requirements.

Table 6.6 Scores report for efficiency rating all Growers in sample

Grower Number	Efficiency Score %	Grower Number	Efficiency Score %	Grower Number	Efficiency Score %	Grower Number	Efficiency Score %
1	100	11	100	21	100	31	100
2	100	12	100	22	100	32	100
3	100	13	100	23	100	33	100
4	100	14	100	24	100	34	100
5	100	15	100	25	88.74	35	100
6	100	16	100	26	100	36	100
7	100	17	100	27	100	37	100
8	100	18	100	28	100	38	100
9	100	19	100	29	0	39	100
10	88.46	20	100	30	100	40	100

Data Envelopment Analysis Reference Comparison follows the establishment of potential improvement data which is to be used in gaining information about the unit performance in comparison with peers for the adjustment of those variables needed to improve performance.

6.7.4 6 Maximising outputs grower 10 comparisons

To maximise the possible outputs from the given level of inputs for Grower 10 there are seven reference sets or peers in the group of samples used by Data Envelopment Analysis for comparison with Grower 10. These seven Growers within the reference set selected by the programme, Growers 4, 5, 14, 18, 23, 32 and 34 are deemed by Data Envelopment Analysis to be 100% efficient within the whole peer group. Each of the set has the nearest similarity to the input/output orientation of the perceived inefficient unit Data Envelopment Analysis shows complex reference sets of data indicating that 100% efficiency exists in Growers who perhaps excel in a particular output that is not general through the sample. For instance, a Grower producing only cabbages cannot be compared with a Grower only producing apples. When analysing data from these two Growers Data Envelopment Analysis searches for a virtual comparator. None are found and the system decides that both Growers are 100% efficient in the production of the product unique to them. As they are the only two producers of those crops how can they both be 100% efficient when compared to the other Growers in the sample group? This type of standard is therefore unacceptable for benchmark use.

Turner et al [2006] point out the shortcomings of Data Envelopment Analysis and advocate an alternative approach to benchmarking which they describe as Dynamic Benchmarking. The process of conducting Data Envelopment Analysis requires the running of one analysis after another to include or exclude individual cases or variables to test the robustness of the analysis. The alternative dynamic method would require that a new Grower, not included in the original sample, might include their data into the data base already held. The new entrant would specify the important inputs and outputs for a re-run of the analysis which would provide an overall efficiency rating. Time constraints preclude the testing of the Dynamic Benchmarking theory based on the Data Envelopment Analyst System at this stage because a new group of Growers would need to be interviewed in the same way as the present sample of 40. For the purpose of developing the required benchmarks an alternative and more readily understandable analytical method is required and was devised.

6.8 Normalisation of data by Weighted Values £ /Hectare.

The alternative analysis referred to in 6.7.4.6 above is based on the normalisation of area weighted values. The same inputs and outputs used for the full Data Envelopment Analysis detailed in Table 6.4 has been reproduced below for ease of reference to the inputs and outputs used in this revised analysis. This system will clearly show where improvements in productivity can be made by adjustment to various inputs. The results from the analysis should be regarded as benchmarks for existing and new vegetable food crop producers.

As discussed, Data Envelopment Analysis does not provide a straight-forward answer to what, at the start of this research appeared to be a simple question. Normalisation could provide a guide to improvements of output revenue through simple comparison by graphic illustration through the medium of Excel.

Growers 10 and 25 were selected by Data Envelopment Analysis to be below the 100% efficiency level of their peer group with ratings of 88.4% and 88.7% respectively. This efficiency rating is accepted as a guide and will be discussed and compared with the results after analysis by the normalisation of area weighted value methodology. Both Growers 10 and 25 will be analysed by normalisation with Grower 34. Grower 34 was chosen for this analysis because, as with Growers 10 and 25, organic registration is in place; Grower 10 has part-time and full time employees all year and Grower 34 has part time employees at busy seasonal times only; Grower 10 cultivates root crop and leaf crop for cattle fodder and part sale and Grower 34 also grows root and leaf but in addition produces a variety of different crops too, all of which are sold for human consumption.

6.8.1. Normalisation Area Weighted Values £/Hectare for Growers 10 and 34.

Table 6.4 Inputs and outputs for detailed analysis

Inputs	
Number of Hectares.	Registration costs.
Other Registration Costs.	Freehold Purchase Cost.
Annual Rent Per Hectare.	Annual Allotment Rent.
Initial Tool/Equipment Costing.	Annual Tool Replacement/Maintenance.
Annual Full & Part Time Wages.	Annual Seed Save.
Annual Organic Seed Purchase Cost.	Annual Standard Seed Purchase Cost.
Annual Organic Fertilizer Cost.	Annual Inorganic Fertilizer Cost.
Outputs	
Annual Root Vegetable Sales.	Annual Arial Vegetable Sales.
Annual Flowering Vegetable Sales.	Annual Leaf Vegetable Sales.
Annual Arial Fruit Sales.	Annual Bulbous Vegetable Sales.
Annual Herb Sales.	Annual Flower Sales.
Annual Plant Sales	Annual Soft Fruit Sales.
Annual coppice Sales.	Annual course Income.
Annual Home Consumption of Crop.	Total Annual Value All Crops.

Data for Growers 10 and 34 was transferred from the Statistical Package for the Social Sciences software (where it was first recorded) into Microsoft Excel software to facilitate the preparation of two sets of graphs. To facilitate ease in comparison of total inputs and total outputs data is presented on the same graph. For clarity the inputs and outputs are presented with appropriate scales separately as figures 6.5 (2) and 6.5 (3). This method will be applied to a total of six analyses discussed in the following sections. The detail can be seen in Figure 6.5 (1), 6.5 (2) and 6.5 (3). To aid understanding of the abbreviated headings on the X axis of all figures from 6.5, 6.6, 6.7, 6.8, 6.9 and 6.10 a full listing is provided by Figures 6.4 (a) and 6.4 (b).

In the case of Growers 10 and 34 the holdings comprise fifteen hectares and two hectares respectively. The registration costs for both holdings are almost identical although Grower 10 has slightly more than seven times the land area of Grower 2. This initial cost cannot be reduced and neither can the annual cost which is nominal and static.

The first high input to appear in Figures 6.5 (1) and (2) is the land purchase price for both holdings but the difference between the two is small. As the land has been purchased and is in private ownership there cannot be any reduction in input value. In the event that the value of the land has increased since purchase this would not affect the output levels.

Figure 6.4 (a) X axis meanings for Inputs in Figures 6.5 to 6.9 inclusive

Abbreviation	Full meaning
Inputs	**Inputs**
hectares	Total number of hectares on ho holding
anntool	Annual tool and equipment costs
regcost	Annual costs of organic registration
othereg	Annual cost of other registration
purchas	Purchase cost of land per hectare
renthec	Annual rental cost of land per hectare
allotre	Annual allotment rent
toolequ	Initial tool and equipment costs
ptfwags	Total full time and part time wage costs
seedsav	Annual value of seeds saved
seedcos	Total annual seed cost
staseco	Total standard seed costs
orferco	Annual organic fertilizer costs
inferco	Annual inorganic fertilizer costs
input total	Total Annual input costs

Figure 6.4 (b) X axis meanings for Outputs in Figures 6.5 to 6.9 inclusive

Abbreviation	Full meaning
Outputs	**Outputs**
anroveg	Annual income from root vegetables
arialve	Annual income from arial vegetables
floveg	Annual income from flowering vegetables
leafveg	Annual income from leaf vegetables
arialfr	Annual income from arial fruit
bulbveg	Annual income from bulbous vegetables
herbs	Annual income from herbs
flower	Annual income from flowers
plants	Annual income from plants
softfru	Annual income from soft fruits
coppice	Annual income from coppice
course	Annual income from courses
tothmva	Total annual value of crops use home consumption
cropval	Total annual value of all crops and other output

Figure 6.5 (1) Normalisation area weighted values for £/Hectare Growers 10 and 34 Inputs and Outputs

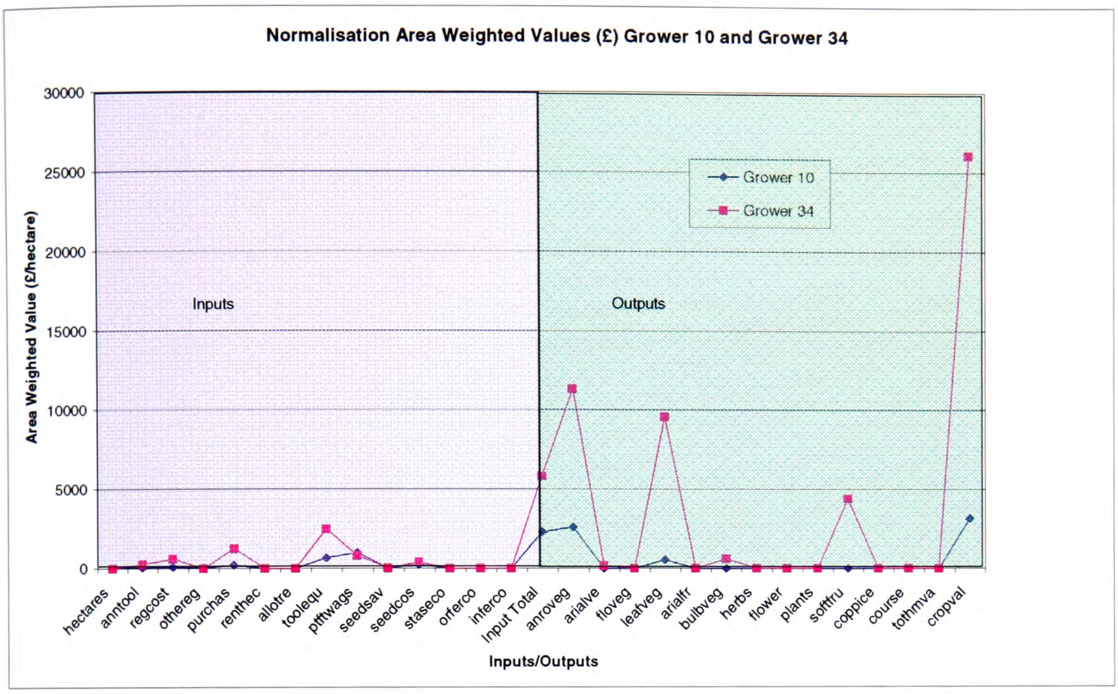


Figure 6.5 (2) Normalisation area weighted values £/Hectare for Growers 10 and 34 Input only

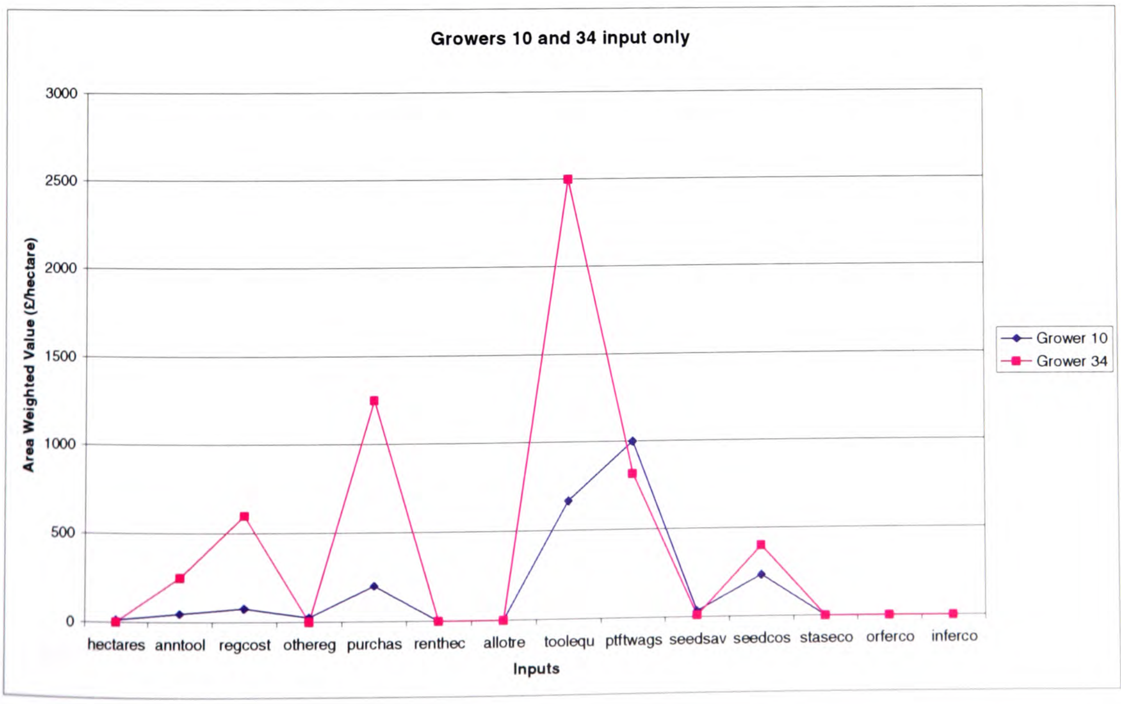
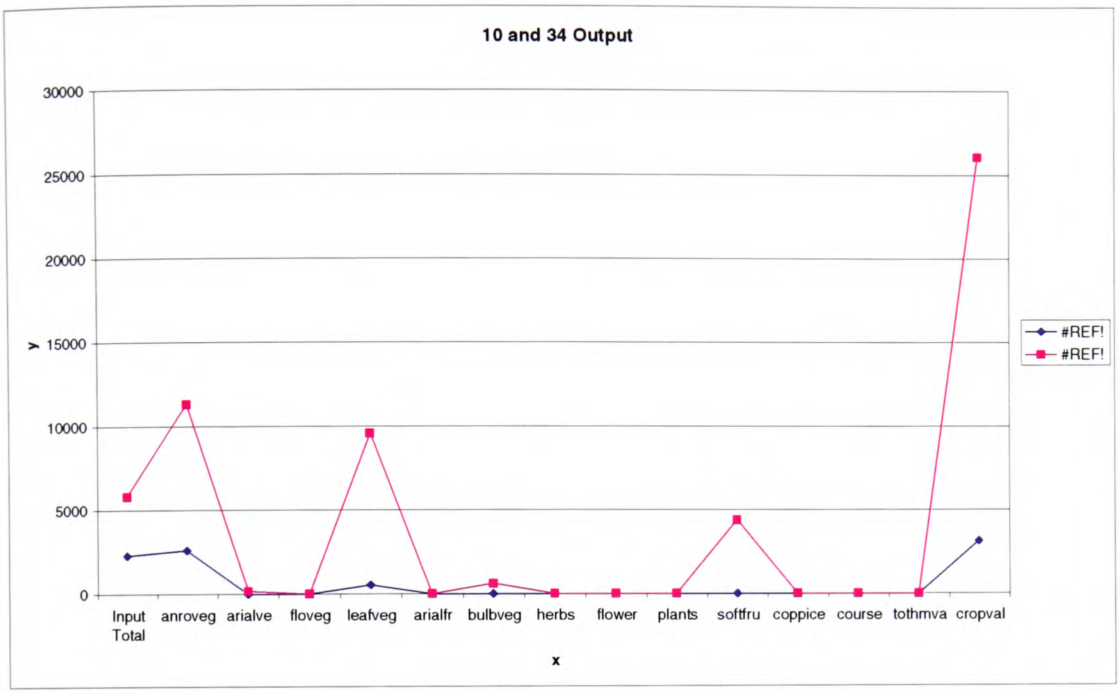


Figure 6.5 (3) Normalisation area weighted values £/Hectare for Growers 10 and 34 Output only



In fact, if land input costs were included in the equation as a higher input value due to increased land values there would be an adverse affect on total input costs rather than a beneficial one.

The first two prominent inputs for examination are labour costs and initial tool requirement costs for both Growers. Although Grower 10 has in excess of 7 times that of the land area of Grower 34 the initial tool costs are only twice those of Grower 34 which could be regarded as sound management of resources by Grower 10 if accepting that the land area would require a different category of tool use; a tractor for instance. One must consider that Grower 10 uses most of the land for grazing organic cattle and grows vegetable food crops mainly as feed for the stock. Consequently there is obviously an output from the cattle in terms of milk production but a high input cost for livestock. This anomaly cannot be resolved without recourse to the examination of other Growers in a similar situation and the addition of this data to the present data set. However, the total value of crops produced whether fed to animals or sold is available and can be considered precluding the cattle enterprise although it would be of interest to know the financial benefits of converting such vegetable food crop produce to milk production. The final analysis will be unreliable in this case because taking into account the land area relevant to total output of vegetable food crops will produce a result net of the output from cattle grazed on some of the land.

Tools are regarded as capital investment for both Growers and their value can be 'written down' annually for tax purposes plus of course there is tax allowance for yearly maintenance costs. Grower 10's tool maintenance input is marginally higher than Grower 34's and could provide a small reduction of input costs if maintenance could be safely reduced.

Seed save cost is of importance too but it should be remembered that seeds saved are part of the previous year's crop and raises the question 'is seed save an input or an output' which is an issue that need not be decided here. Consequently seed save and organic seed costs must be considered as a total input. In the case of Growers 10 and 34 there are no standard seed costs to consider because both are organic producers. For Grower 10 the total seed input is £4,000.00 which equates to about 5 times that of Grower 34's £820.00. Annual output of 2 vegetable food crops for Grower 10 totals £47,178.00 but for the much smaller Grower 34 the total output for a variety of 5 crops is greater at £52,171.00. A small difference but again the issue of milk production could be important.

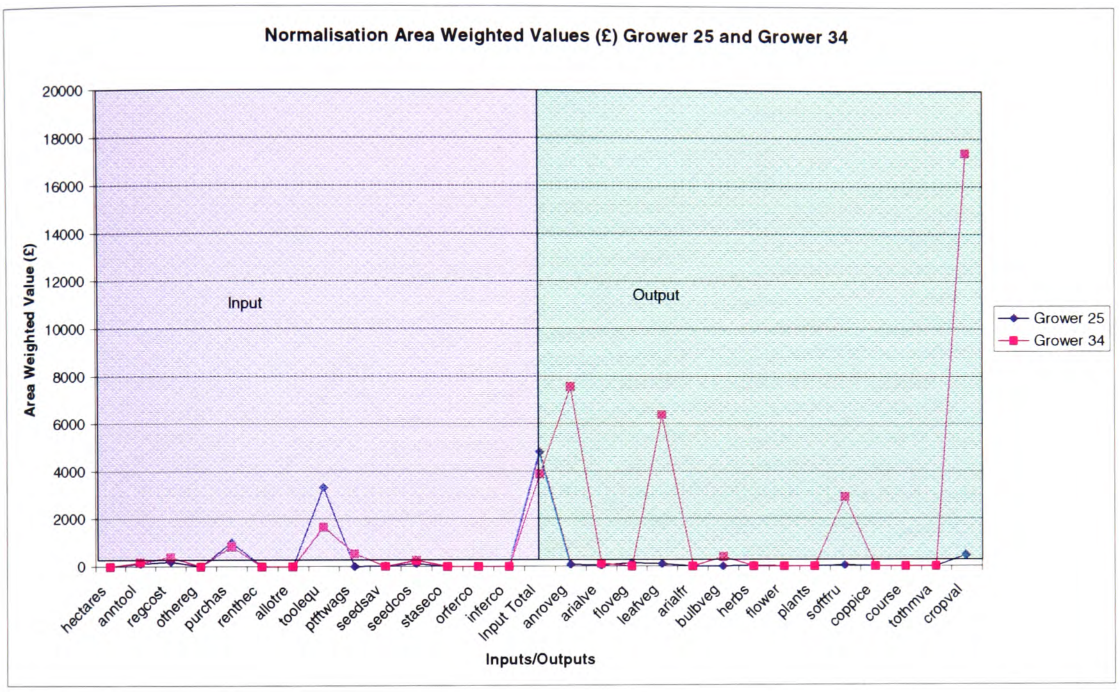
The input total for Grower 10 accrues to £34,220.00 and for Grower 34 to £11,652.00. From this is would appear that a reduction in seed costs may well help to make Grower 10 a more profitable concern but one cannot consider that seed for grazing grass may be included and maybe that eventuality would again result in milk production. As mentioned above, milk production is not included as an output because it is not contained in the initial data base...

6.8.2 Growers 10 and 34 summary

Comparing these two Growers normalising their output by land area shows that Grower 10 has a production rate of £3,145.00 per hectare but Grower 34 produces £26,085.00 per hectare. On the input side Grower 10 provides £2,281.00 per hectare and Grower 34 £5,826.00. The significant differences represent the anomaly of Grower 10 using vegetable food crop as cattle feed and producing output from milk production for which no data exists. Even so, if the crop was sold as Grower 34 does it would still show lower output in monetary terms than Grower 34 but from a holding seven times the size but partly used for grazing. Comparing these two Growers shows that by reducing wages to the same level as Grower 34, Grower 10 would make a saving of £13,368.00 reducing his total input to £20,852.00 which is still far above the level of Grower 34's. The question then arises 'can the fifteen hectares be sustainable and productively managed with the same wage input as two hectares'. The question of animal husbandry is again evident as the wage costs for it are included with the crop raising element; the Grower was unable to provide separate costs. It is established here that benchmarks for vegetable food crop production would be difficult to establish to improve Grower 10's outputs.

6.8.3 Normalisation Area Weighted Values £/Hectare for Growers 25 and 34.

Figure 6.6 (1) Normalisation area weighted values £/Hectare for Growers 25 and 34



Grower 25 cultivates a two and one half hectare holding in Powys, a sparsely populated area which covers 25% of Mid Wales and Grower 34 has two hectares in Ceredigion, a smaller county which includes West Coast areas with a larger population. Both Growers are registered organic producers and are about seventy two miles apart. Grower 10 discussed in the chapter 6 section 8.1 farms in the Vale of Glamorgan in the extreme South of Wales about forty eight miles from Grower 25 and eighty four miles from Grower 34. Each area is climatically different because of location and diverse topography. The weather affects every aspect of agricultural practice but although the survey obtained rainfall, land aspect and drainage data for all cases these elements are not been considered in the analysis.

Figure 6.6 (2) Normalisation area weighted values £/Hectare for Growers 25 and 34 Inputs only

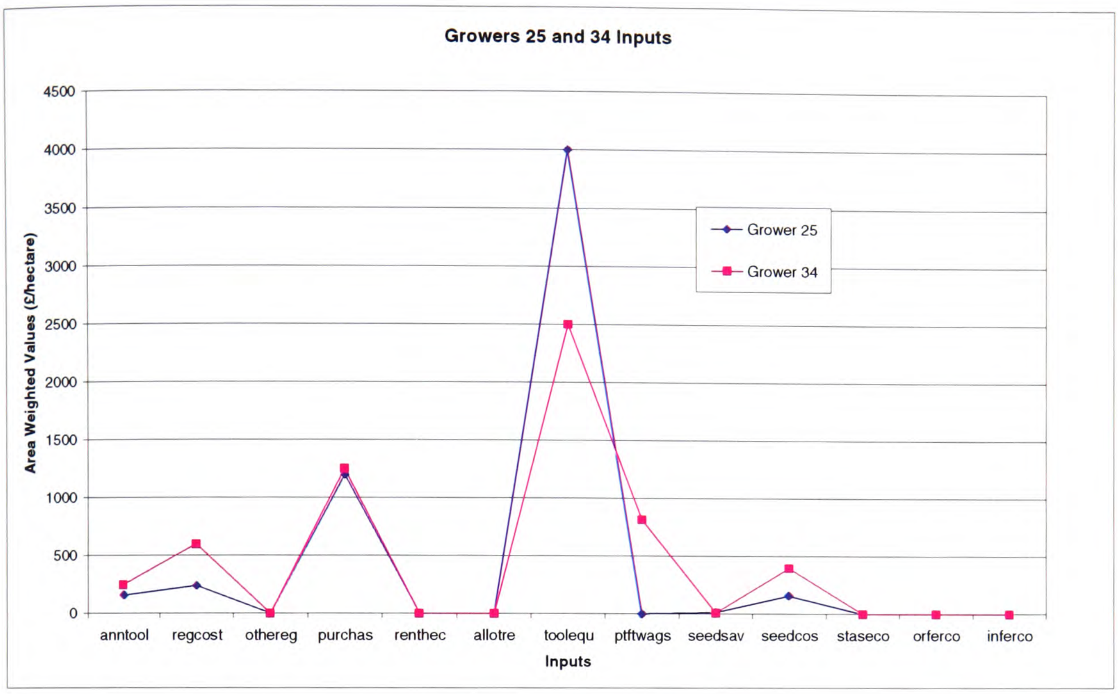
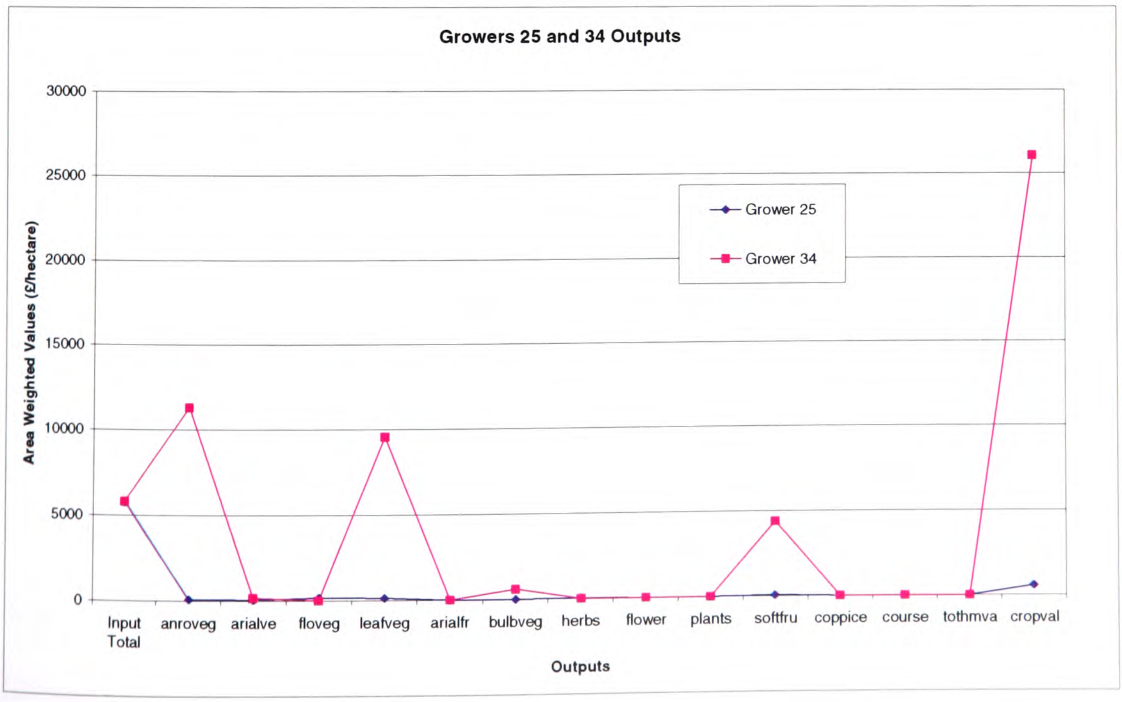


Figure 6.6 (3) Normalisation area weighted values £/Hectare for Growers 25 and 34 Outputs only



Each of the six case studies for comparison in this thesis show different inputs and outputs for discussion. Examining the same inputs and outputs for all Growers is not feasible using the method of analysis being used because of diverse differences which have been shown in the normalisation of Growers 10 and 34. For instance, although the registration costs for Growers 10 and 34 are of similar amounts when the registration costs for Growers 25 and 34 are compared they are of dissimilar amounts. In this instance Grower 34's registration input is double that of Grower 25's but no saving can be made as reduction of the amount is not possible. Similarly the land purchase cost cannot be reduced and neither can the increase in land values be added to the inputs without adverse affect. Normalisation can only be applied to the generic inputs and outputs common to the Growers involved which can be adjusted to suit the purpose of input reduction for more profitable and sustainable output.

The initial tool input costs for Grower 25 is £10,000.00 which is twice that of Grower 34 and the annual tool maintenance cost for Grower 25 is £100 less than Grower 34's input of £500. The reduction of initial tool input as a capital cost is not possible and one can only speculate that gross overspend when setting up the business was responsible for the high cost. Grower 25 is a husband and wife partnership and no wage or consumption of produce inputs are recorded although they should require some remuneration but Grower 34 inputs £1,632.00 for wages. Seed costs from seed save for Grower 25 are, at £40.00, twice that of Grower 34's declared £20.00 but organic seed costs of £400.00 are half those of Grower 34. Efficiency attributable to total seed costs is evident for Grower 25 until one examines the total crop output of Grower 34. The difference in total input is minimal; £14,440.00 for Grower 25 and £11,652.00 for Grower 34. Figure 6.5 shows that Grower 34 produces output of vegetable food crop of

£52,171.00 from two hectares whilst Grower 25 records total output of £1414.00 from two and one half hectares.

6.8.4 Growers 24 and 34 summary

Comparing these two Growers (25 and 34) and normalising their output by land area shows that Grower 25 has output of £565.60 per hectare but Grower 34's output is £26,085 00 per hectare. On the input side Grower 25 provides £5,776.00 per hectare and Grower 34 £5826.00. For almost identical input per hectare (£50.00 more for Grower 34) the value of output is minimal for Grower 25 even if the initial tool and equipment cost could be totally removed. The Data Envelopment Analysis software put the efficiency of Grower 25 as 88.7% compared to Grower 34's 100% efficiency. Normalisation of area weighted value per hectare established by this analysis shows that the efficiency of Grower 25 for output per hectare appears as 2.17 % efficient compared to Grower 34. Clearly Grower 25 at this efficiency level cannot be regarded as having methods worthy of imitation. If the output for Grower 25 is compared to that of Grower 34 to establish percentage efficiency from total inputs a figure of 99% efficiency is shown which could be regarded as a desirable benchmark.

6.8.5. Normalisation Area Weighted Values £/Hectare for Growers 5 and 32.

Grower 5 is an allotment holder in the Pontypridd area of South Wales cultivating a standard plot 30.00 feet x 100.00 feet (9.1 metres x 33.3 metres), providing 304.7 m^2 - about 29 m^2 less than the Harlow Carr experimental plot of land. For the purpose of this analysis the land area of a standard allotment plot has been rounded up to half a hectare although in reality standard plots are equivalent to 0.03 of one hectare. A variety of seven crops are produced by Grower 5 sometimes using insecticides and fertilizers and according to Data Envelopment Analysis this Grower (5) is 100% efficient within the peer group. Crops produced are for home consumption and also distribution amongst fellow gardeners on an exchange basis to provide others involved with greater vegetable variety.

Grower 32 is organic registered and farms at Lampeter in Ceredigion Mid-Wales. This holding is situated some 75 miles distant from Grower 5 and was at time of survey producing four crop types for sale direct to local packers.

Figure 6.7 (1) Normalisation area weighted values £/Hectare Growers 5 and 32 Inputs and Outputs

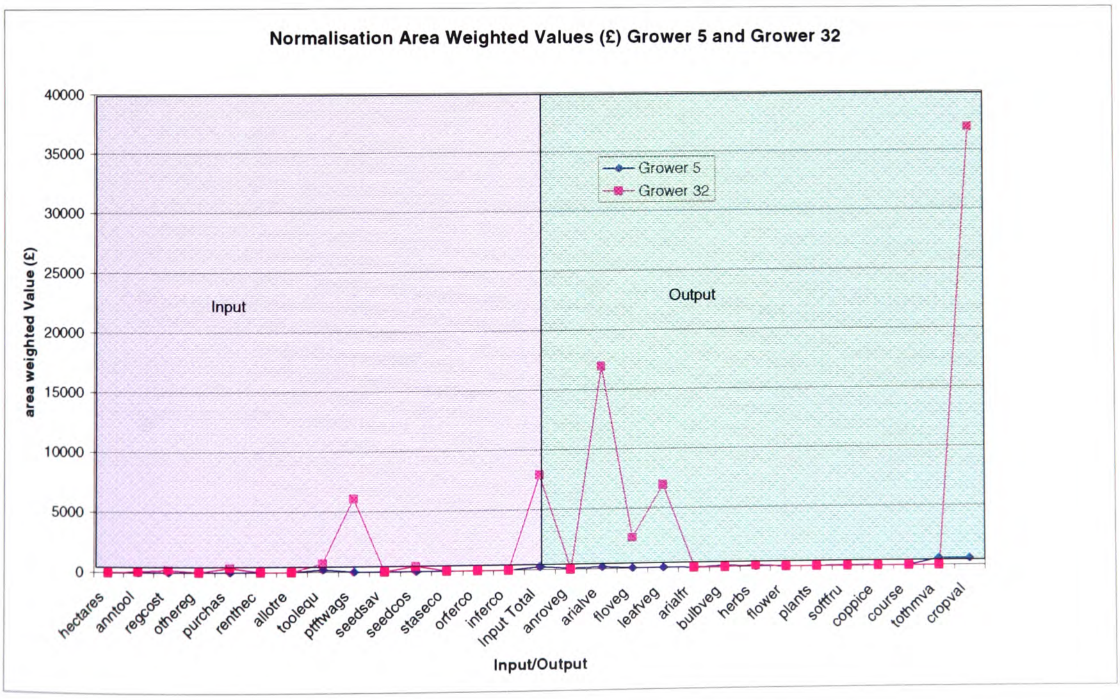


Figure 6.7 (2) Normalisation area weighted values £/Hectare Growers 5 and 32 Inputs only

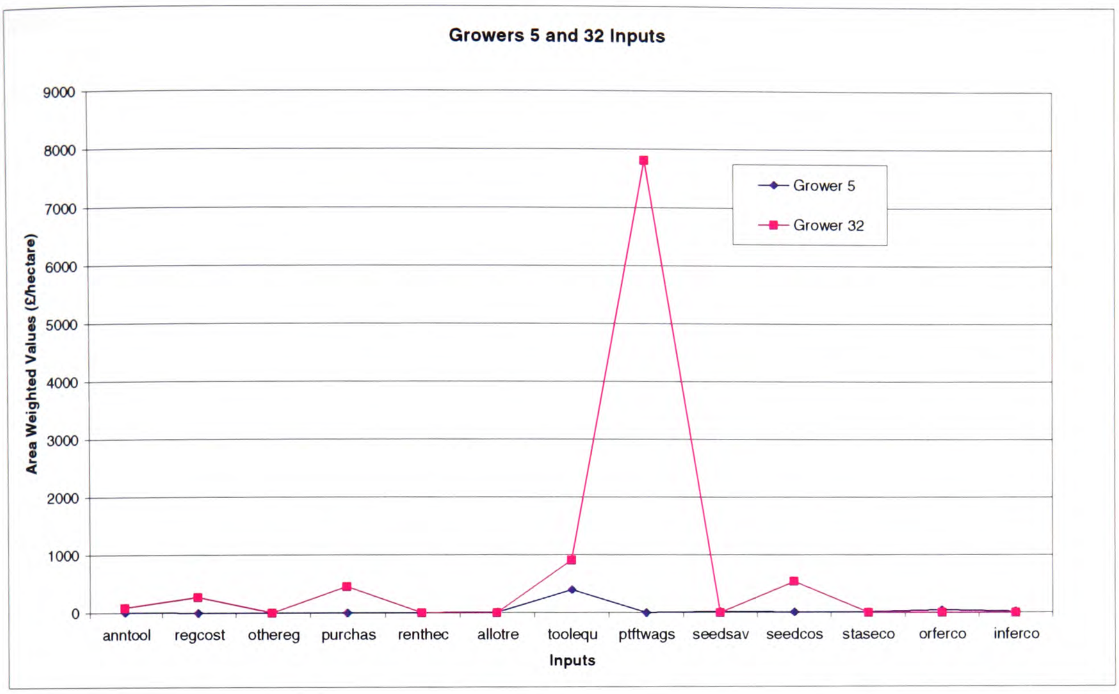
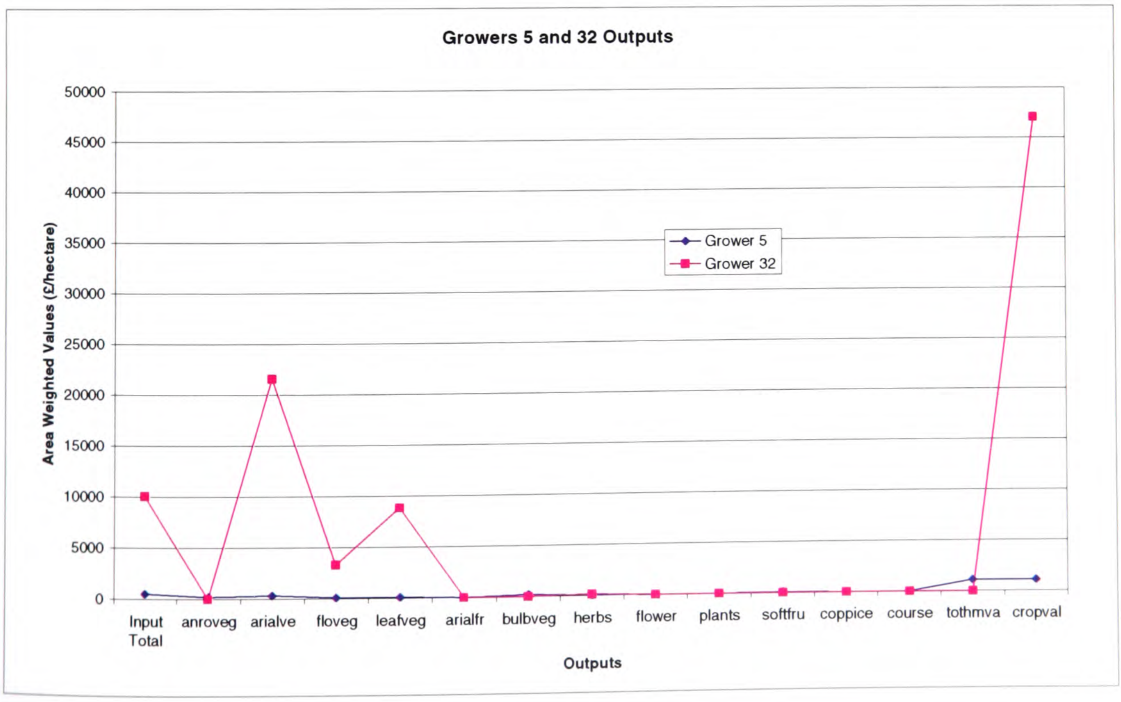


Figure 6.7 (3) Normalisation area weighted values £/Hectare Growers 5 and 32 Outputs only



Grower 32's area of cultivation is eleven times that of Grower 5's. The annual and initial tool inputs are vastly different; Grower 32 has recorded one hundred times and twenty five times respectively the amount of inputs declared by Grower 5. As an allotment gardener Grower 5 has no registration costs whereas Grower 32 expends £1,500.00 annually. Grower 32 has purchased the land for £2,500.00 per hectare and Grower 5 pays a nominal rent of £5 per annum to the local authority which owns the allotment site. Wages are zero for Grower 5 but £42,609.00 per annum for Grower 32. Seed costs for Grower 5 are a mixture of half seed save and a quarter each for standard seeds and organic seeds totalling £20.00 per annum. Grower 32 has a total seed cost of £3,000.00 per annum. The total inputs for Grower 5 are £260.00 per year and for Grower 32 £55,469.00. Grower 5's total crop output value is a modest £552.00 annually and Grower 32's equates to £259,076.00.

6.8.6 Growers 5 and 32 Summary

Normalising these two Growers (5 and 32) by land area shows that Grower 5 (cultivating half a hectare) has an output equivalent to £1,104.00 per hectare and Grower 32 has an output of £47,104.00 per hectare. Grower 5 provides total input of £520.00 per hectare and Grower 32 £10,085.00 per hectare. Assuming that Grower 32 rented the land at the same rate as Grower 5 which would equate to £13.75 per annum for the 5.5 hectares; thus land input costs would reduce by £2486.00. Removing Grower 32's registration costs would also make considerable differences, making a combined total reduction of £3986.00. Lack of registration would reduce gain from output as organic produce does attract a higher retail selling price. This changes the total input to £51,483.0 or £9360.00 per hectare which differs minimally from the original figure of

£10,085.00. However, Grower 32 has an output about four hundred and sixty nine times that of Grower 5 although not inputting on the same scale but at a rate of about two hundred and thirteen times that of Grower 5. The tool costs for Grower 32 are considerable and wages are relatively high too. Reducing Grower 32's tool and wage costs to the same level as Grower 5's again alters the equation considerably reducing the inputs for Grower 32 to £3219.00 or £585.00 per hectare; just £65.00 in excess of Grower 5s input. This is an example of cost reduction whilst maintaining the same outputs. However, Grower 5 is a sole worker on a small plot of less than 0.5 hectares and it is doubtful that Grower 32 could maintain the present output on a single handed labour basis on a plot eleven times larger. From this example it is apparent that it may not be possible to reduce Grower 32's input to increase production or indeed maintain it. Both Growers appear to be efficient in their own way. Grower 32 is a commercial enterprise whilst Grower 5 is a hobby gardener without any market pressures. On a benchmarking basis Growers of similar types need to be compared.

6.8.7. Normalisation Area Weighted Values £/Hectares for Growers 5, 6, 7, 8 and 26.

Growers 5, 6, 7, 8 and 26 are all allotment plot gardeners. The first four cultivate plots on the same allotment site in Trefforest, Pontypridd South Wales and Grower 26 has a plot in Cardiff. All of the plots are the same size, half a hectare. Figure 6.7 shows inputs and outputs for all five and Figures 6.7a and 6.7b show inputs and outputs separately. There are slight differences in the annual rent payments within this group. Growers 5, 6 and 7 pay £5.00 per annum and, although on the same site, Grower 8 pays a concessionary £2.50 because he is disabled. Grower 26 pays Cardiff Council £20.00 per annum for the plot. There is a shortage of available plots in Cardiff and ready availability in the Pontypridd area which may account for the higher city rent charge. The analysis of these five Growers shows a comparison which could be described as 'like for like'. This is because they are the only cases producing vegetable food crops on the same scale for similar inputs. Conversely their outputs are more dissimilar.

Figure 6.8 (1) Normalisation area weighted values £/Hectares Growers 5, 6, 7, 8, and 26 Inputs and Outputs

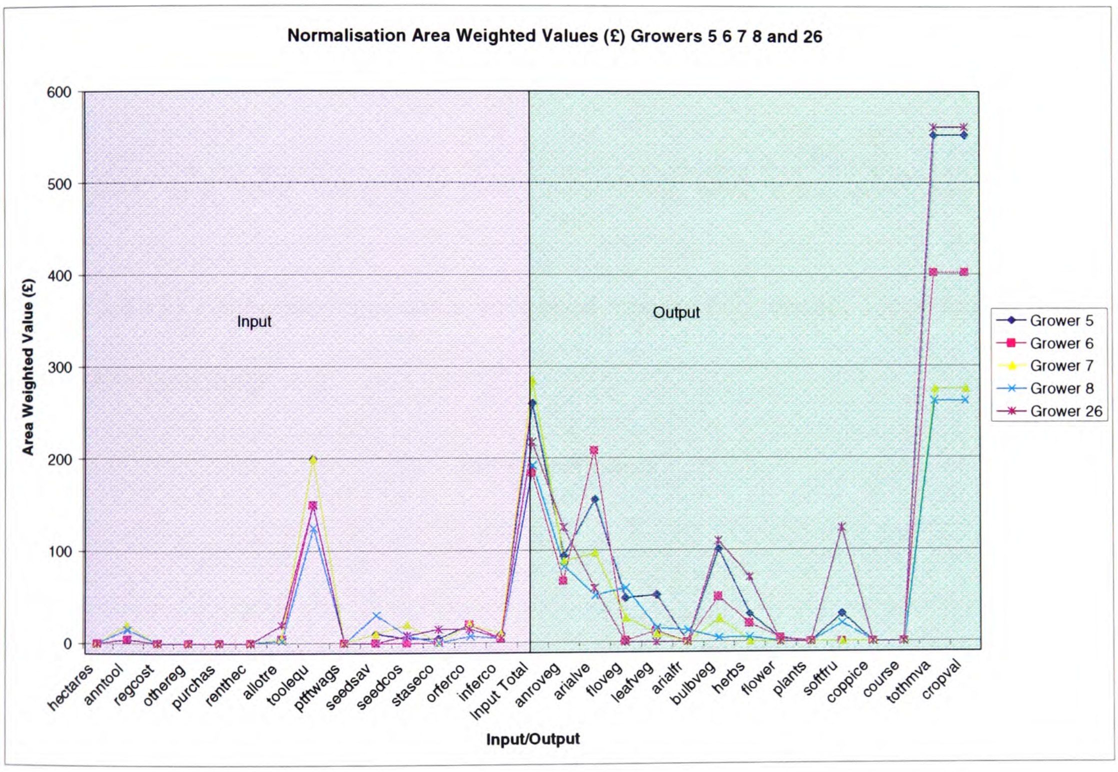


Figure 6.8 (2) Normalisation area weighted values £/Hectares Growers 5, 6, 7, 8, and 26 Inputs only

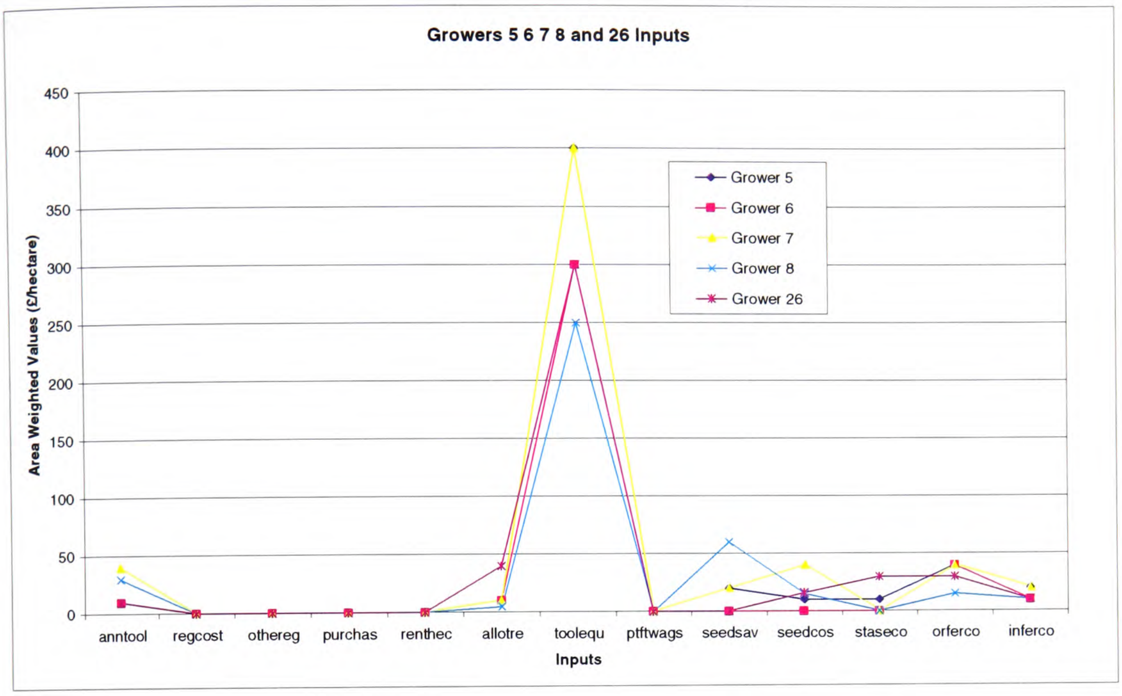
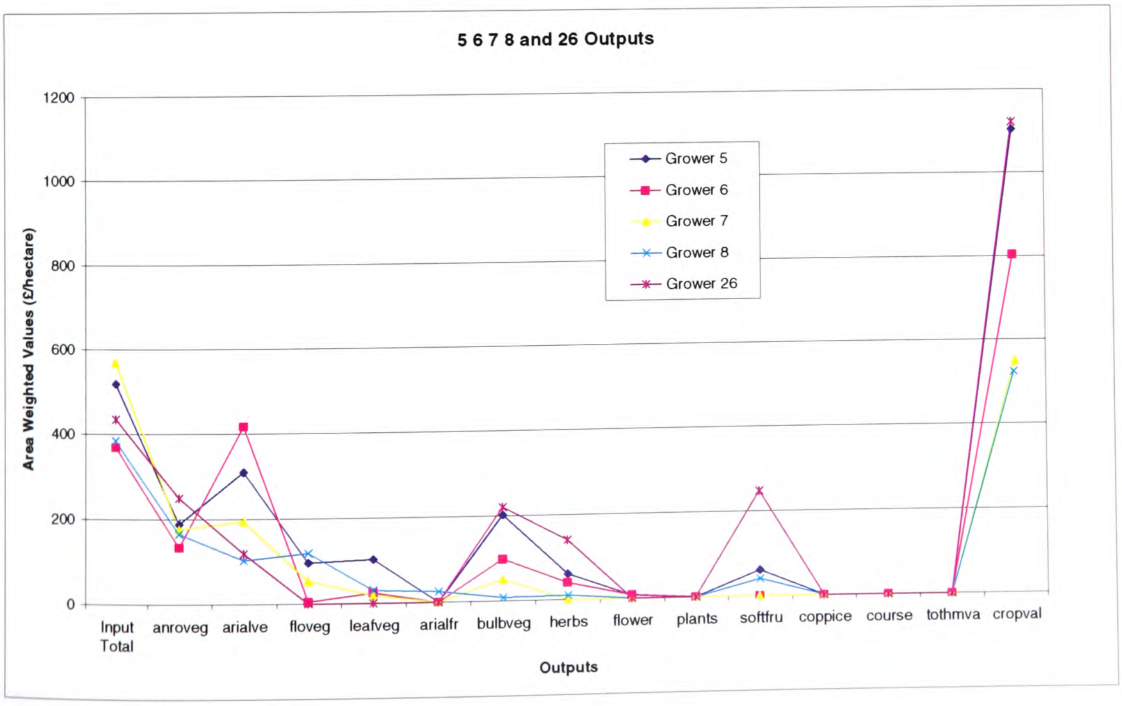


Figure 6.8 (3) Normalisation area weighted values £/Hectares Growers 5, 6, 7, 8, and 26 Outputs only



No wage, land purchase or registration costs are incurred by these five Growers which keeps total inputs at a low level in most cases. Growers 5, 6 and 26 declare annual tool costs of £5.00 but Grower 8 spends £15.00 and Grower 7 £20.00. Growers 5 and 7 show £200.00 as an initial tool requirement; Growers 6 and 26 £150.00 and Grower 8 the lowest at £125.00. Their annual tool and equipment requirement is the same for Growers 5, 6 and 26 at £5.00 but Grower 8 spends £25.00 and Grower 7 spends £20.00. The seed save variables are zero for Growers 6 and 26; at the £10.00 level for Growers 5 and seven but Grower 8 inputs £30.00. Organic seed costs for Growers 5 and 6 are £5.00 whilst Growers 7, 8 and 26 input at higher levels of £20.00, £7.50 and £8.00 respectively. Cost of standard seed input for Growers 5 and 26 are £5.00 and £15.00 respectively and Growers 6, 7 and 8 are recorded as zero. Organic and inorganic fertilizer costs constitute a high percentage of total inputs if combined. Examined on a separate basis organic fertilizer is the dominant in usage. Growers 5, 6 and 7 use £20.00 each and Growers 8 and 26 £7.50 and £15.00 respectively. Growers 5 and 7 use inorganic fertilizers to the value of £10.00 each and Growers 6, 8 and 26, £5.00 each. Total inputs for Growers 5, 6, 76, 8 and 26 are £260.00, £185.00, £285.00, £192.50 and £218.00 respectively.

The highest output recorded within this group of five cases is for Grower 26 as £561.00 which equates to £1,122.00 per hectare; this input is £436.00 per hectare. If the rent could be reduced to the equivalent of the other four cases in this group (5, 6, 7 and 8) the small saving of £15.00 would reduce inputs to £406.00 per hectare. It can be seen that annual tool requirements cannot be reduced as it is already at the low level of £5.00 yearly. Grower 26 does not save seed so could reduce total seed costs by doing so. Grower 26s' nearest best performance in the group is Grower 5 who saves seed to the value of £10.00 annually. If Grower 26 reduced seed purchase costs from a total of £23.00 by £10.00 seed save (provided that the seed saved was not re-classified as an output from the previous year and it could be accepted that the seed save figure be regarded as fiduciary) declared by Grower 5 his (Grower 26s') inputs would be reduced further to £386.00 per hectare. The cropping of produce to the value of £1,122.00 for an input of £386.00 appears to be an efficient position compared to others within the analysis. This example shows that small reductions in input costs can be made from the data available and could be regarded as a form of benchmarking having established Grower 26 as the best of the best in this small group. It is possible that Grower 26 could improve by the output of higher value crops and the same applies to others in the group. The main objective of the research is to establish benchmarks and on that basis Grower 8 with the lowest output within this grouping is in need of some advice to improve efficiency. Grower 8 produces crops to the value of £262.00 equivalent to £524.00 per hectare with inputs of £385.00 per hectare. The rent is 50% of that levied on other Growers on the same allotment site and it is doubtful that it could be further reduced. Annual tool costs are treble those of Growers 5, 6 and 26 and if set at the same level would reduce total input. Grower 8's total seed requirement (seed save and seed cost combined) is 60% higher than that of the apparently efficient Grower 26; consequently improvements are also possible with seed consumption. Grower 8 produces eight crop types whilst Grower 26 cultivates only 5. Assuming that Grower 8 reduced annual tool costs to £5.00 creating a saving of £10.00 and total seed costs to the same as Grower 26 to provide a further saving of £14.50; these savings would reduce total inputs to £168.00 equating to £336.00 per hectare which is still a high input for the production of crops to the value of £524.00, less than half the value of Grower 26s' production.

Next of the group with the second lowest output is Grower 7 with five crop varieties valued at £275.00 or £550.00 per hectare with an input of £385.00 per hectare (Grower 26 has five varieties) There is room for reduction in Grower 7's inputs especially annual tool costs which are four times higher than Grower 26s'; reduction to Grower 26's level could save £15.00 yearly. High seed costs could be reduced to the level of Grower 26s' creating a further saving of £7.00. Another high cost input variable for Grower 7 is expenditure on fertilizer; in this case £30.00 (combined organic and inorganic) whereas Grower 26 inputs £20.00. This could provide another £10.00 saving for Grower 7 making a total of £32.00 and therefore reduces input to £253.00 equivalent to £506.00 per hectare supporting an output of £550.00 per hectare making production costs some 92% of output value. This is a poor return but is an improvement on present performance in which inputs are more than output. Grower 7 has an expensive hobby-as one could buy organic vegetables at a marginally lower cost than growing them. If the cost of labour were to be included in inputs losses would be dramatically higher. Grower 7's hobby, at least provides good healthy outdoor exercise. Social activity with fellow gardeners combined with consumption of fresh produce may also be advantageous.

Within the allotment holders group Grower 6 takes third position in the output league by producing crops to the value of £402.00; equivalent to £804.00 per hectare. The inputs are the lowest in the group at £185.00; £370.00 per hectare. This is a ratio of 46% of produce cost. The biggest cost is organic fertilizer which may, together with the variety of crop grown, be the secret of this success. It would be virtually impossible to reduce Grower 6s' inputs which are all relatively minimal. Amongst seven crop categories grown his biggest output, representing half of his harvest, is arial vegetables which are of high value. Root vegetables follow valued at £67.00; the lowest value production rate and herbs and bulbous vegetables contribute as higher value produce too. Grower 26 at the top of the crop value list within this group produces five vegetable types with very high value soft fruit at the top of his list followed by bulbous vegetables and low value root vegetables: arial vegetables represent the lowest crop value. The two top value Growers, 26 and 5, have at least one high value crop each and keep their inputs to a minimum. However, Grower 5 could tackle his inputs by reducing seed and inorganic fertilizer costs to the level of Grower 6s'.

Grower 5 produces eight crop types and has an output of £1,104.00 per hectare and inputs equivalent to £520.00 per hectare. Inorganic fertilizer costs are twice those of Grower 6 and could be reduced to the same level for environmental benefit as they represent the capacity to produce only just £54.00 extra crop value above that of Grower 6s'. The seed costs for Grower 5 are fourfold those of Grower 6 and if reduced to the same level in addition to a reduction of inorganic fertilizer costs, a saving of £20.00 would reduce inputs to £500.00 per hectare which is far in excess of Grower 6s'costs of £370.00 per hectare.

6.8.8 Growers 5, 6, 7, 8 and 26 Summary

Comparing inputs with outputs within this group of five cases has revealed that the establishment of benchmarks is achievable even with the reduction of inputs. Lack of business acumen rather than agricultural knowledge could be the reason that some Growers provide higher inputs than outputs which in some instances are of less value than the inputs. Previous comparisons 6.8.1, 6.8.2 and 6.8.3 showed less clarity in this respect because of extremes of diverse input and output variables. Because the producer types within the samples considered (6.8.1, 6.8.2 and 6.8.3) include large and medium producers and differ considerably from Growers in allotment locations there is a need for a system such as Data Envelopment Analysis with the capability to create virtual comparators. As described above (6.7.4.6) such a system is overly complex and not particularly suited to this research in respect of the mixture of producers because it produces 100% efficient Growers on a virtual basis. Data Envelopment Analysis results are illustrated by graphs but are difficult to interpret. Constant time consuming re-running of data analysis is necessary to obtain results some of which are available from simple normalisation using Excel graphs shown above. The research for this thesis was directed at vacant small land plots and allotment sites and the data collected from similar holdings is ideal with which to benchmark small scale vegetable food crop production in those situations using the normalisation procedure. To further test this theory the following two sections will compare two small commercial Growers and the five allotment gardeners discussed above and one of the small producers with one of the same allotment gardeners.

6.8.9. Normalisation Area Weighted Values £/Hectares Allotment Growers and Growers 2 and 4

The circumstances and situations of Growers 5, 6, 7, 8 and 26 have been described 6.8.4 above. Growers 2 and 4 are situated about one hundred and ten miles apart and ninety four miles and 35 miles respectively from Growers 5, 6, 7, 8 and 26 (all of whom garden on the same allotment site). Grower 2 is an affiliate of the wholesome Food Association and operates on a Land Trust site in the Newtown area of Powys and collects green waste from local residents to make compost which is used on the land to grow six vegetable food crop varieties. Unused compost is returned to the vegetable waste donors for use in their gardens. The Trust also runs horticultural (including composting) courses. Grower 2 is one of two from the whole sample of forty producers in the research to keep accurate and detailed records of all sales and incomes but has not revealed income from donations and grants. Grower 2 can be considered as a standard in some respects although of course it should not be regarded as 'the best of the best'. As discussed previously, establishing the 'best of the best' on which to benchmark others is not easily attainable.

Grower 4's growing area is situated in the three hectare walled gardens of a large country house about three miles from the town of Brecon in the Brecon Beacons National Park. The estate surrounding the house and garden is a productive farming and silviculture enterprise in the ownership of the same family as the house and walled gardens. However, the estate production is not included in the survey because the walled gardens are a separate recently registered organic unit established by the owners as a trial project before converting the whole estate to organic production of milk, meat and vegetable food crops. At the time of survey garlic and potatoes were being harvested as trial from the first organic year of production. The owners were experiencing difficulty marketing about six thousand garlic bulbs locally and, whilst being interviewed, were pickling the cloves in small jars which they hoped to sell to up-market stores in London. Thirty tonnes of potatoes were clamped and being sold gradually in local outlets. These two crops were used, on the instructions of the registration body, to keep the soil productive during the conversion period.

Figure 6.9 (1) Normalisation area weighted values £/Hectares Allotment Growers and Growers 2 and 4

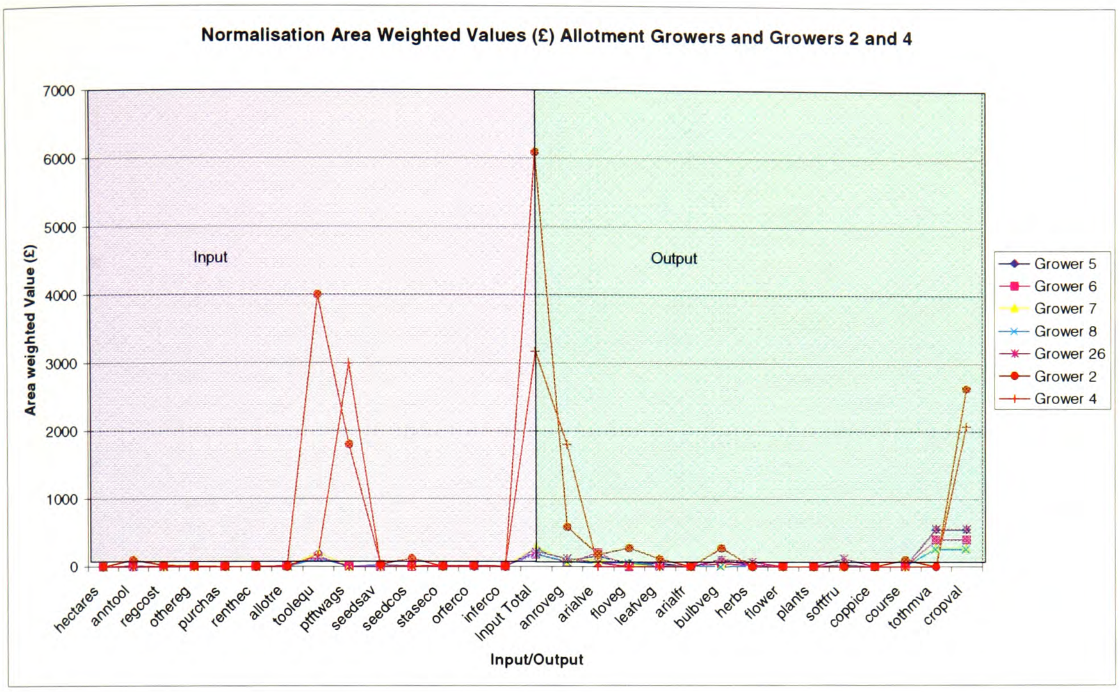


Figure 6.9 (2) Normalisation area weighted values £/Hectares Allotment Growers and Growers 2 and 4 Inputs only

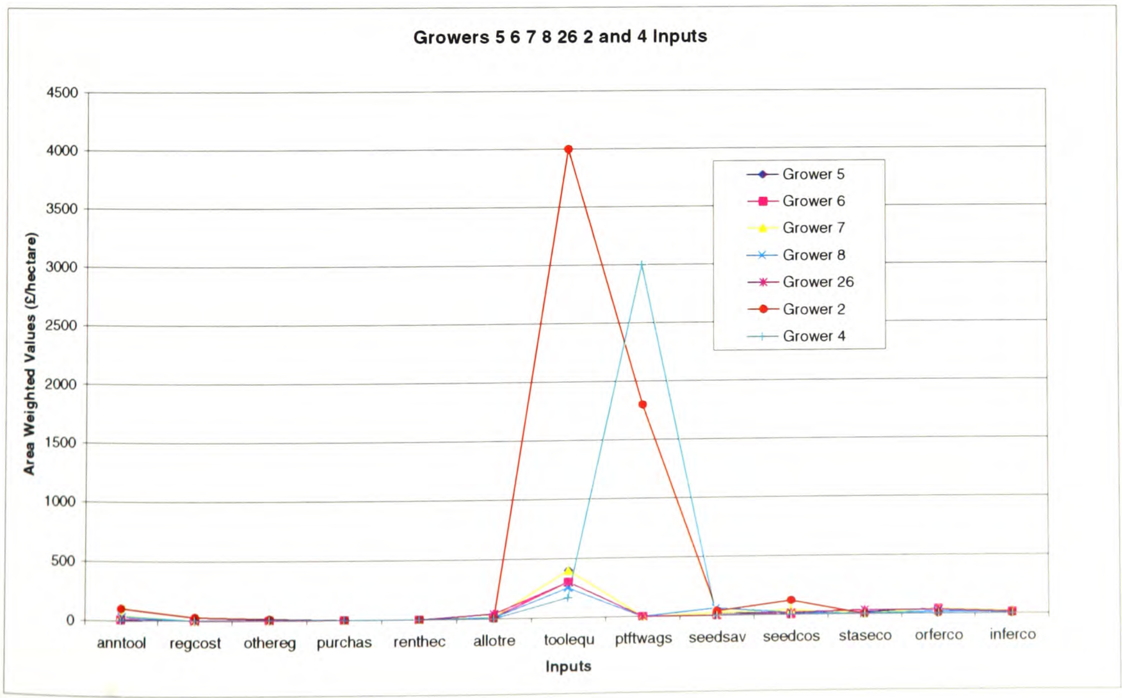
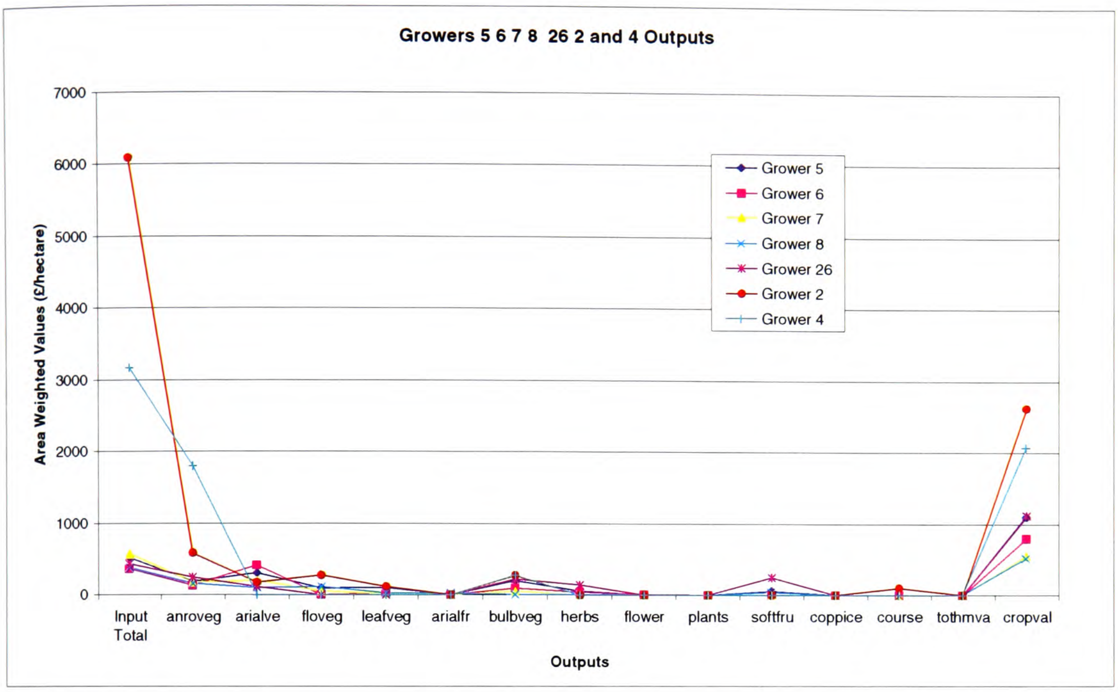


Figure 6.9 (3) Normalisation area weighted values £/Hectares Allotment Growers and Growers 2 and 4 Outputs only



Figures 6.8 and 6.8a above show that Grower 2 had an initial tool requirement of £4,000.00. The reason for such a high input could partly be as a result of purchasing composting equipment. This initial tool cost is far above the initial expenditure of the five allotment Growers which equates to an average of £165.00 each. Grower 2 has declared an annual cost of £100.00 for maintenance of tools; ten times that of the allotment holders each of which has an average expenditure of £10.00. Grower 4 does not declare any annual amount which may be due to the use of tools and equipment belonging to the adjacent farm enterprise. Grower 4's initial equipment costs are £500.00, equivalent to twice the average of the allotment Growers. Grower 2 has twice the land area of each allotment holder and Grower 4 six times the area. For Grower 2's small area the annual cost initially seems excessive but the composting equipment is a constantly rotating steel drum and maintenance is fundamental for safety reasons. It

appears there is little scope to reduce this particular input. Wage inputs for Grower 2 are £1,800.00 or 29.5% of the total £6,090.00 input and 68% of the total output. Seed costs from seed purchase are £120.00 and seed save of £35.00 save represents 2.5% of the total inputs and 5.9% of the total outputs. The total input per hectare is £6,090.00 representing a loss of £3,465.00 against total outputs of £2,625.00. It appears that labour costs are evaporating into the compost operation which shows no return for its output. Vegetable food crop sales and income from courses run for educational purposes produces the entire £2,625.00 output. However, non-participation in composting by those earning the £1,800.00 wage input would not cover the total loss unless their labour contribution could be redirected to increase food crop output. This Grower is a Trust Enterprise and is funded by gift and grant income undeclared during the survey but should be deriving additional income from the compost it now returns freely to the community. The approach is one of community benefit and environmentally sustainable methods but also needs to be profitable. Grower 4 is also in a loss making situation although the initial tool requirement is declared as £500.00 which represents 5.25% of total input for an area three times that of Grower 2 and six times that of the allotment gardeners. There is no provision declared for tool maintenance which may be due to the adjacent farm enterprise being responsible for tools borrowed by Grower 4. Registration fees are minimal but will increase considerably on completion of conversion so at this stage there is no obvious saving to be made. Grower 4 declares a wage input of £9,000.00 which equates to 94.6% of total input. There is no seed cost recorded for Grower 4 although there must have been some such costs to produce the original trial crops which represent the output of £6,225.00 for two crops (estimated £5,400.00 for potatoes and £825.00 for garlic). The total input per hectare is £3,169.00 and the output is valued at £2,075.00 per hectare. This yields a loss by Grower 4 of £1,094.00 per hectare. Of all the allotment gardeners only Grower 7 shows a loss which as shown in 6.8.4 above could be remedied by this normalisation method of benchmarking. The overall loss shown in the data for Grower 4 equates to £3,283.00 and reduction of wage inputs by a minimum of £5,717.00 to establish a break even figure appears as the only way of developing a viable business. It is difficult to comprehend that such a high wage input can be justified to produce two crops using mechanised methods. The cooking, peeling and packing of garlic for sale was carried out by the owners who claimed that they were not claiming any remuneration by salary. The cost of glass jars and labels for garlic pickling was not evident in the survey so may contribute to an even higher financial loss.

6.8.10 Growers 2 and 4 Summary

Growers 2 and 4 are both loss makers and could benefit significantly from advice by the allotment gardeners (with the exception of Grower 7's performance, but that could be improved by following the input procedures of Growers 5, 6, 8, and 26 from the same group). Small allotment plot Grower 5 generates income of £1,104.00; Grower 6 £804.00; Grower 8 £524.00 and Grower 26 £1,122.00 per hectare. The allotment gardeners pay no wages which is to their advantage and they cultivate more varieties of produce than Growers 2 and 4. However, if wages are disregarded for Grower 2 it can be seen that it is still not as efficient an operation as the successful allotment holders 5, 6 8 and 26 because in the case of Grower 2 the inputs would still exceed the outputs by £1,665.00. It is not possible to remove the initial capital equipment costs of £4,000.00 invested mainly for compost production with no monetary return but if that is disregarded and the inputs thus amended to £290.00 a level of efficiency can be reached to produce the same £2,625.00 per hectare. Grower 2 should seek to lower seed costs which at £155.00 per hectare are far in excess of all the allotment Growers requirements which are for Grower 5 £40.00; Grower 6 £5.00; Grower 7 £60.00, Grower 8 £67.50 and Grower 26 £46.00 per hectare. Grower 2's maintenance costs of £100.00 could be reduced also without the continuing composting device requirement.

In the case of Grower 24 wages form the highest of the input variables and if reduced to zero would return the Grower an output of £2,075.00 per hectare for inputs of £169.00 per hectare. As a commercial enterprise Grower 4 will have some wage inputs and should, in line with allotment Growers, produce more crop varieties which command higher retail prices to generate higher income from the same land area.

CHAPTER 7

CONCLUSIONS

Chapter 7 Conclusions

7.1 Introduction

The research for this thesis originated from the idea that small vacant land and allotment plots in Wales could be used for the local production of vegetable food crops on the premises that

- land is a finite resource.
- present food production and food distribution methods are unsustainable.

Many aspects of agricultural land use, and mis-use, play a prominent part in this work. Food production and distribution globally, nationally and locally have featured.

The thesis's introduction referred to the Brundtland Report of 1987 which dealt with social, environmental and economic issues connected to sustainability. The thesis is relevant to all those debates. By implication present horticultural production methods within the UK and the increasing importation of food is clearly unsustainable. The connection of this thesis with these wider issues is the establishment of benchmarks for the effective growing of vegetable food crops close to their point of consumption. Appropriate benchmarks could provide small local producers of vegetable food crops with sustainable economically viable growing procedures, products and markets.

With global and national ecological footprints in mind, the literature review considered the implications of food transportation. Issues outlined included vegetable food crop import/export and UK production. Use of agricultural chemicals and their effect on human and animal well-being through ground and atmospheric pollution together with economic implications were also explored.

This chapter will present conclusions that can be drawn from this research to illustrate problems connected with vegetable food crop production and the need to establish benchmarks to be employed to ensure efficient localised vegetable food crop production by communities, individuals or other groups. Perhaps established growers, amenable to change, or community groups and other organisations would consider benchmark testing in order to achieve more sustainable and profitable production.

7.2 Conclusions

Bishop et al (2002) reveal that the ecological footprint for Wales calculates the average Welsh citizen to have an ecological capacity of 5.2 hectares to support their current lifestyles. It is a sobering thought that if every person on the Planet Earth had the consumption pattern of Welsh people, nearly two additional planets would be required to sustain them. The Welsh, and indeed the ecological capacity of other nations, is clearly unsustainable. Local production of vegetable food crops within Wales could contribute to the reduction of Wales's ecological footprint. To facilitate such a contribution there needs to be quantified assessments of vacant unused land and a process to facilitate local vegetable crop cultivation on a sustainable economically viable basis for small groups. Although activities and cultivation procedures of some allotment gardeners have been considered, the principal data has been obtained from a sample of small growers. There is no data in the thesis which chronicles vacant waste land plots which the author, early in the work, realised would be an insurmountable task he would be unable to even partly attempt within the constraints of this study. This was primarily because of locating, listing and tracing patterns of ownership.

The fundamental requirement of this work is the establishment of reliable production benchmarks. It should be noted that ecological foot prints are guides in specific and understandable terms developed from scientific data. These guides could be defined as benchmarks. Combined with the economic and sustainability objectives of the proposed benchmarks is the aspect of human and animal well-being. Natural cultivation of vegetable food crops locally, by local people, could also provide healthy outdoor exercise. Additionally the research shows that consumption of fresh vegetables is the second most effective strategy for preventing cancer after stopping smoking tobacco products. Furthermore, local vegetable food production, or indeed any communal activity, could make a valuable contribution to social cohesion.

The 5.2 hectares ecological capacity calculated for Welsh citizens highlights some statistics pertinent to land use. 1,730,000 hectares of diverse agricultural land in Wales represents a small proportion of the total UK agricultural land area. The figure does not include unused allotments or other vacant areas which could be productive in rural, semi rural and urban locations. It is estimated that 20% or more of allotment sites are vacant within the UK. Although a survey in England reports the total number of allotment plots, there is only an estimate of the total for Wales. However, the 20% unused availability within Wales could be put to productive use by individuals or community groups. These groups could include schools, hospitals, community centres and other institutions. Research also established that 40,000 hectares of farmland disappears under buildings, roads and leisure developments each year in the UK as a whole. No separate statistic is available for Wales. The implication is that the loss could be significant and, although vacant allotments could compensate, vacant and perhaps derelict land areas could be utilised for localised vegetable food crop production. As with vacant allotment plots there are, as far as the author can ascertain, no available modern statistical details or estimations of vacant unused land plots suitable for the uses specified above.

This research shows that diverse scientific evidence has revealed detailed damage to land, aquifers and atmosphere from intensive agricultural practices and food transportation. It has not established that specific pollution reduction could be attainable by localised vegetable food crop production preferably by natural methods using reliable benchmarks. The avoidance of agri-chemical use and transportation over long distances would, by implication, reduce pollution. Similarly, home production avoids contributing to the UK balance of payments deficit. Chapter 2 section 2.6 established that money spent with local suppliers is worth four times as much as money spent with non-local suppliers. Also, buying food in local farmer's markets generates twice as much for the local economy than buying food in supermarkets. Two other important points established are that small farms are some 2 to 10 times more productive than larger farms and more local production generates considerably more employment opportunities.

Chapter 3 chronicled the history of organic food production and outlined its benefits including healthy soil, healthy food and, consequently, healthy people. Reasons for stimulating consumer demand and marketing methods were considered. Major concern was expressed that 75% of the UK food requirement is imported at great environmental cost which far out weighs any advantages of choosing organic produce. There are allegations by global companies that organic and local produce are no healthier than non-organic and that organic agriculture increases the risk of food poisoning. Using organically approved pesticides damages the environment they argue and consumers pay too high a price for the produce. Furthermore, they state, organic food cannot feed a hungry world and organic farming is cruel to animals. Needless to say this debate continues. Every aspect of the claims by the global companies is disputed through research by numerous public interest groups. The author believes that stringent rules applied to organic growers within UK for conversion, production, preparation and distribution of produce is, considering all relevant issues discussed in this thesis, both ethically and environmentally robust.

Chapter 4 provided an overview of allotment history and cultivation within the UK. Of particular interest were the statistics for food production during World War 2 during which allotment holders produced 1.3 million tons of fresh food on existing plots. Government estimated that 500,000 extra plots would produce enough vegetable and potatoes to feed another one million adults and 1.5 million children for eight months of the year. This is significant in that subsequent to the war use of allotments declined but gardens provided with local authority housing allowed considerable space for vegetable cultivation. This situation has now changed with new housing developments lacking garden space and the burgeoning supermarket industry of the 1970s and early 1980s. However, the author concludes that the food scares of the 1990s and early years of the 21st century, discussed in this thesis, have stimulated the present demand for allotment space. The research shows that health, domestic and social considerations plus economics are the principle concern of applicants for allotment sites. A good cross cultural comparison of need for home grown vegetable food crops has been shown by reference to the Cuban situation. Cuba, forced by international politics and the loss of supplies from the former Union of Soviet Socialist Republics, found itself in the situation of needing self sufficiency quickly. Every suitable and available land space was then designated for food production. Crops are now produced solely by sustainable organic methods and 200,000 new jobs were created as a result. The environmental benefit implications are positive and financially rewarding. In the year 2000 every square metre of spare land in Cuba produced 27 kilograms of food with a 30% annual increase projected. Further research concluded that Cuba had achieved a 250% annual growth rate of fruit and vegetable production by the year 2001. Cuba has a population approximately one fifth of the UK and has approximately half the land area. The Cuban climate is more conducive to plant growth. Comparison of the UK and Cuba is relevant because of the reduction in Cuba's ecological foot-print as a result of its revised horticultural practices. According to the United Nations Environment Programme every citizen of Cuba requires 1.4 hectares of productive land or sea to provide their needs and the people of the UK require 5.4 hectares. Total hectares available on the planet are 1.8 hectares per person. This thesis advocates a system of organic localised vegetable food crop production; not necessarily to provide employment but to provide healthy exercise, diet and social cohesion with economic benefit and more importantly a systematic reduction of the UK ecological footprint.

There has been minimal research into allotment production within the UK. The 1975 Harlow Carr experiment showed produce of 1.95 kilograms per square metre vegetable food crops to the total value of £745.00 (at 2004 organic produce values) harvested from a standard 333m^2 allotment plot over the year. Estimations by Pretty (2001) show that annual crop, (no weight stated) value of £1,870 is achieved per allotment plot of unstated size within the UK. This figure, if correct, represents a £561 million contribution to the UK economy. Recent research by Vazquez (2000) shows allotment crop output of 259 kilograms valued £400.00 per standard plot. The four Pontypridd allotment gardeners included in the survey for this thesis produce an annual average annual crop valued at £438.00. Crop produce weights from these plots are known but have not been extrapolated forward. However, the monetary values established by this project (average £438 annually per plot) vary only marginally from the Harlow Carr and Vazquez results. All three significantly differ from Pretty's estimations (£1,870 per plot). It is apparent that the estimated 300,000 UK allotment plots must be producing food (at the lower estimation of £438 per plot) to the total value of approximately £131.5 million annually which is not included in the Mintel [2001] report that each UK citizen consumes vegetables to the value of £2.00 weekly and is somewhat remote from Pretty's estimate. Each allotment produces approximately enough vegetables to 'feed' four persons. The 300,000 plots should feed about 1,200,000 people. On this basis if each of the 58 million UK inhabitants consumes vegetables to the value of £104 per year the UK will need to establish another 1,500,000 allotments or small land plot sites of similar size to totally eradicate vegetable food crop imports. In Wales the number of plots is estimated as 15,000 which, based on the results of this research, may produce crops to the value of £6,570,000; enough to feed approximately 60,000 people. The population of Wales (2001 Census) is 2,903,085. This level of vegetable requirements will approximately treble the number of allotment plots to provide the additional produce required to eliminate imports. It is clear that these extra allotment requirements would be difficult to acquire because of various constraints. Land is a finite resource especially in urban areas. It is clear that farmland now set aside should be cultivated to produce vegetable food crops in addition to the use of vacant allotments and other available small plots of land. Under the Common Agricultural Policy UK farmers are paid to maintain the environment rather than grow crops. This encourages more imports, especially from Europe to the detriment of the environment and the balance of payments deficit – although European trading is not included. We should remind ourselves that the farmer's payments are from British taxpayer's contributions to the funds of the European Community. Use of set aside land for vegetable food crop production by organic means could also encourage and develop wildlife diversity. Research has shown that habitats and species thrive within present organic growing situations.

The establishment of benchmarks for vegetable food crop production on small land areas presents numerous problems. This is even more apparent when research shows an enormous difference between the amount of home or domestic produce available and the vast quantities imported. Growing equivalent quantities on small plots would require considerable enterprise, investment and ingenuity.

It was recognised that benchmarking requires identifying best practice to establish benchmarks in a particular 'operation'. How do we positively and unambiguously identify and assess an enterprise, procedure or method, to establish the 'best practice' on which to base our benchmarks. All producers differ in multifarious ways. Land use for the growing of any particular crop type is governed by numerous constraints. For example different soil: different aspect: different fertilizer: different surroundings: different labour input: different irrigation. A cursory appraisal of any plot will reveal that aspect, drainage or perhaps topography will determine use. Other factors require more detailed examination. To facilitate a full programme of research it was decided that detailed physical details of a number of sites presently used for vegetable food crop production should be recorded. Additionally the volume and type of crops together with monetary value and all inputs are fundamental to the study.

Benchmarks for vegetable food crop production need to be simplistic and precise to provide the most efficient transformation of inputs into profitable outputs by sustainable means. To that end it was decided to use a personal interview questionnaire to elicit as much crop production detail from a chosen selection of growers.

Work for this thesis has not found published research with which to construct benchmarks for small vegetable food crop producers. However, some other agricultural benchmarks exist relative to vegetable field crops and cereals but are inappropriate in the context of small scale production. On that premise it was deemed necessary to create a framework which could provide data necessary to provide benchmarks fundamental to small existing producers and new comers within the community and other organisations. It is the author's intention that reference can be made to a simplistic 'benchmark' chart or manual by inexperienced growers for guidance of best practice. As research continued it was realised that numerous idiosyncratic problems are an intrinsic part of vegetable food crop production. However, to facilitate the possibility of creating benchmarks detailed insights were sought from established growers.

After a trial questionnaire was tested within the University of Glamorgan an extensive questionnaire for personal interview of growers was designed. All horticultural inputs and outputs used by each trial case were included and a separate section was included for business procedures. It was estimated from the experience with the trial interviews that approximately thirty to forty minutes would be required to complete each questionnaire. Growers are busy people working long irregular hours sometimes under what might often be described as primitive conditions. Difficulty was encountered making initial contact by telephone at which time prospective interviewees asked numerous questions about the basic purpose of the study. Those agreeing to be interviewed totalled forty. Their premises were in diverse parts of Wales. Travelling to meet them was time consuming and all interviews required more than the allotted time to complete. Some growers required up to four hours to recount their production rates. This was because, with few exceptions, book-keeping records were minimal or non-existent. It was realised that the data obtained is the best available on which to base a practical benchmarking programme for small producers. Under these circumstances, and aware of comment by Wheater [2003] ‘in questionnaire design there may be sound reasons for not collecting the most detailed data’, it may have been more appropriate to select perhaps six growers of diverse types and to have prepared a detailed study of each as a general growing guidance manual.

The structured questionnaire was divided into ten sections; the first nine comprising 95 questions with 1657 possible answers and the tenth comprising 33 questions with 213 possible answers. The variables included all important aspects of small and medium scale vegetable food crop growing and small business procedure. On completion of the questionnaires a method of analysing the data to obtain a formula for benchmarking had to be determined. The initial intention was to use the Statistical Package for the Social

Sciences Software system of analysis but the software was unable to accommodate the vast amount of data collected. At this stage Banxia Frontier Analyst Software Data Envelopment Analysis programme with the ability to process numerous variables was selected for the task

Extrapolation of variables considered most appropriate to the immediate needs of creating a benchmarking process was completed initially to simplify and conduct a trial analysis. Using eleven of twelve sample cases analysing 4 input and 8 output variables an interesting result of grower efficiency percentages was obtained. Results of the trial analysis of questionnaires using Data Envelopment Analysis for 11 of the 12 sample cases (shown in Table 6.2) surveyed demonstrate that, after comparing like with like, six are of equal efficiency and therefore rated as 100% output efficient for the four input and eight output variables selected for analysis from the 1570 available. The twelfth sample grower (10) was initially disregarded through lack of variety in output variables; the producer was not cultivating such a comprehensive range of vegetable food crops as the other growers in the sample, and those that were cultivated were not amongst the sample selected for analysis in this research project. Also, the entire vegetable food crop production of this grower (10) was used mainly as cattle fodder with small surplus quantities sold for human consumption. However, when this grower (10) was included in the trial 78.70% efficiency was evident. Grower 4 was, at survey time, in organic conversion growing and harvesting garlic and potatoes; crops which were a minor part of the other eleven growers' crop production. Within the six cases showing 100% efficiency there are variables showing up as inefficient against the same elements within other cases in the peer group, although all six are within the boundary of 100%

efficiency on an overall basis. The remaining five growers showed various efficiency levels shown in Table 6.2.

If Grower 10 remains in this trial analysis, the other scores do not alter, but Grower 10's score remains at 78.70 % efficiency, producing leaf and root vegetable food crops. This illustrates that Data Envelopment Analysis is comparing like for like, regarding the crop production of the peer group as shown in column 4 of Table 6.2.

Because of the extreme variety in the mix of inputs and outputs only a broad generalisation of production analysis could be made. Analysis using Data Envelopment Analysis software takes each grower in turn and constructs from the other growers an ideal comparison which produces the same outputs but notionally uses minimum inputs.

Table 6.2 Trial analysis Growers efficiency levels

Grower	Produce Types	Efficiency Rating	Efficiency Rating when including G10
1	Mixed VFC's	100 %	100 %
2	Compost and VFC's	100 %	100 %
3	Mixed VFC's	13.90 %	13.90 %
4	Garlic and Potatoes	100 %	100 %
5	Mixed VFC's (Allotment)	100 %	100 %
6	Mixed VFC's (Allotment)	87.80 %	87.80 %
7	Mixed VFC's (Allotment)	56.27 %	56.27 %
8	Mixed VFC's (Allotment)	63.67 %	63.67 %
9	VFC'S and Soft Fruit	100 %	100 %
10	Leaf Vegetables and Dairy cattle	0	78.70 %
11	Mixed VFC's, Soft Fruit and Plants	100 %	100 %
12	Mixed VFC's	12.03 %	12.03 %

Within a small data set with a large number of inputs and outputs, Data Envelopment Analysis has a tendency to indicate that all operational units are 100 per cent efficient; an observation in qualitative terms expressed mathematically. For instance, a grower who only produces carrots cannot be compared with a grower producing only strawberries. When the data from these two growers is analysed using Data Envelopment Analysis no virtual comparator is available. As a consequence Data Envelopment Analysis assigns a 100 per cent efficiency rating to both growers. This of course is not of any applied use. What is needed is an answer to the question 'what are the appropriate methods for ensuring that small plots of land are used effectively for growing vegetable food crops close to their point of consumption'. At the same time the method must be sustainable as well as financially viable.

With the above conclusions in mind the author decided to conduct full analysis of a selection of variables using Data Envelopment Analysis. The main purpose of the study is to establish benchmarks for sustainable production and economic viability and the selection of variables suitable for inclusion was made on that basis. Table 6.3 below shows the 14 controlled inputs and 14 outputs selected to reflect monetary costs and returns. Submission to Data Envelopment Analysis provided complex potential improvement charts, scores reports and efficiency ratings when the inputs and outputs of growers were compared. The results were inconclusive and failed to provide the desired fundamental benchmarks for small scale vegetable food crop production. However, it has since been realised that Data Envelopment Analysis could be adapted and termed Dynamic Benchmarking [Turner et al] 2006. By this dynamic benchmarking method, a new grower not included in the original sample, could add their data to the data base established by this research. The new grower could then specify which of their inputs and outputs they thought important to them. Finally the whole analysis could be re-run to establish their performance against that of their peers. Time and other constraints imposed on the gathering of complete input/output data sets from new cases at this stage of research preclude the testing of this alternative research goal.

Therefore another method of analysis termed Area Weighted Value was devised to use the same data subjected to Data Envelopment Analysis to further test the theory of benchmark provision for vegetable food crop production. It provides a reliable guide showing growers included in the present study how they can improve output by taking certain actions on inputs to increase profitability. Inconclusive Data Envelopment Analysis results and more conclusive Area Weighted Value Analysis results discussed in chapter 6 show that the Area Weighted Value system is simplistic but still cannot supply a complete answer to the original question posed in the thesis. However Area Weighted Value Analysis brings a different and less complex perspective to the task and can provide a benchmarking process.

A major problem with Data Envelopment Analysis for analysing new growers, or others intending to acquire benchmarks, is the requirement to complete the comprehensive interview questionnaire and then to add all input and output variables to the data base. Because the questionnaire is so detailed the input and output variables require time consuming manual transmission from Word Excel on to Data Envelopment Analysis software. The Data Envelopment Analysis software programme then requires a re-run to complete a full analysis developing virtual comparisons where necessary to establish efficiency ratings for the entire peer group including any new entrants. Data from the new entrants would then affect the efficiency ratings of the growers already in the peer group. These requirements also apply to the newly devised dynamic benchmarking system using Data Envelopment Analysis software. There is an advantage that the original users of the data base could benefit from this additional data supplied by the new entrants.

Area Weighted Value Analysis is much more 'user friendly' for the purpose of benchmarking commercial criteria; especially if the growers are broadly similar. For example, chapter 6 section 8.4 demonstrates that five allotment gardeners analysed can easily be compared and strategic decisions made to reduce inputs in line with their peers to improve their input/output ratios. Chapter 6 section 8.5 demonstrates that commercial growers of similar size can find meaningful benchmarks if compared with allotment growers. The system is more difficult to utilise for benchmarking within a peer group containing samples which produce diverse crop varieties, practice monoculture or grow crops of dissimilar types. However, that analysis is not impossible as chapter 6 sections 8.1, 8.2 and 8.3 demonstrates. At the same time new entrants to the data base could assist the practices of the existing participants by bringing new standards and practices from which all could benefit.

For the original Data Envelopment Analysis fourteen inputs and fourteen outputs were included from a total of 1657 variables. These twenty eight variables were selected because sustainable environmental and economic viability is paramount to the research design. Table 6.4 chapter 6 shows the same twenty-eight variables now chosen for Area

Weighted Value Analysis.

The Area Weighted Value System using Word Excel allows graphical analysis of the input and output variables considered most important by an individual grower to be compared with the same variables for growers already contained within the data base. As shown in chapter 6 a method for benchmarking vegetable food crop production has, to a limited extent, been established. Making monetary alterations to the business input variables for vegetable food crop production in small scale operations can be usefully informed by reference to the simple graphical illustrations presented. The Excel graphs showing inputs and outputs in one format with £ values on the x axis and inputs and outputs on the y axis give an overall picture with growers individually listed and colour coded. Graphs showing inputs and outputs in separate format are constructed in the same mode. By separating the input and output variables, scrutiny of the comparison between grower's inputs or outputs is more easily identifiable because the illustration is both more clearly legible and easily interpreted

.

To illustrate the type of input reductions for increased profitability and sustainability Growers 8 and 5 provide a simple example. By examining Figures 6.7, 6 7a and 6.7b it can be seen that Grower 8 has higher annual tool maintenance costs; three times that of Grower 5 and additionally Grower 8s' crop output value is less than half that of Grower 5s' but the total combined seed inputs vary considerably. For Grower 5 total seed costs are £20.00 and for Grower 8 these are £37.50. The cultivated areas are identical and the number and varieties of crop outputs are the same; eight varieties for Growers 5 and 8. With this information it can be seen that Grower 8 should reduce seed and annual tool costs to be more financially efficient and if this Grower (8) increased production of high retail value soft fruit, herb and bulbous vegetable growing, reduced low value crop and also cultivated some flowers, the output value should rise considerably. Although soil and other physical land details are not included it should be noted that there is no topographic or soil differences as both growers occupy the same allotment site and have adjacent plots. The horticultural skills of either Grower are unquantifiable without detailed study but could be dramatically affecting Grower 8's performance.

Another of the comparisons which illustrates the ease of using the normalisation analysis system is the data for Growers 2 and 4. The first is a land trust unit with funding for compost production from food waste collected in its local area. There are no monetary input details in the data to show a contribution to the compost activity. The monetary output shown is solely from vegetable sales and a training course input is some 232% more in monetary terms than the output of vegetable food crops. Immediately the graphical illustration of normalisation is scrutinized it is apparent that the recorded wage input of £1,800.00 per annum is probably consumed in work other than the vegetable food crop production, this is probably by the composting operation as was the £4,000.00 initial tool and equipment costs. This Grower (2) maintained detailed records of all income and expenditure with the exceptions of Trust and compost income. During questionnaire interview it was revealed that compost was returned to the community free of charge which precluded inclusion as an output. By excluding the initial equipment costs of £4,000 or reducing them to Grower 4's level of £500.00 the output of Grower 2 appears just slightly healthier showing output exceeding input by a minimal £35.00 even with the existing wage input of £1,800.00. A reduction of the high seed costs declared as £155.00 is disproportionate to the crop production shown as

£2,525.00 and could also be reduced. If comparisons were to be made between Grower 2 and Grower 34 using normalisation analysis for instance (data to be transferred to graphical format as with all other comparisons described in chapter 6, it would be found that Grower 34 grows five crops on twice the area of land used by Grower 2. The wage input is approximately the same and Grower 34 inputs registration fees in excess of £1,000.00 more than Grower 2. Grower 4's total inputs equate to about twice the inputs for Grower 2 to produce nineteen times the output which should be divided by two to reflect Grower 2's holding size (half the size of Grower 4s'). Grower 2 is revealed as being very inefficient indeed. Even so, Grower 2 declares six crop types mostly of low value produce and one horticultural training course to attain this output. Grower 2 could also be advised to increase high value soft fruit production to increase outputs.

Chapter 6 section 8.5s' comparison of Grower 2 with Grower 4 shows that Grower 4 cultivates two vegetable food crop varieties for a different purpose (as feed for an organic dairy herd) than Grower 2 (or indeed any other growers within the sample).

However, Grower 4s' inputs are 152% higher than outputs showing wage inputs as 95% of the total The land area cultivated by Grower 4 is three times that of Grower 2 and obviously only partly used for vegetable food crop production because the land is used for organic dairy farming (declared in the survey interview as a one off case within the entire study sample; a fact not shown in the data selected for this analysis). The graphs show that Grower 2 cultivates six crop varieties most of which are of high value and Grower 4 cultivates two varieties, approximately only 11% of which is high value.

Data for Grower 4 could be entered into graphical format to be compared with Grower

34. Immediately it would be seen that Grower 4 cultivates one third more land than Grower 34 and that inputs for Grower 4 are 81% (£9,508.00) of Grower 34's (£11,652.00) or in real terms for 91% more land area. This example requires careful scrutiny but shows the adaptability of the analysis and Grower 34 could perhaps be set as the 'best of the best' when compared with Growers' 4 and 2.

CHAPTER 8

RECOMMENDATIONS AND FURTHER WORK

Chapter 8 Recommendations and Further Work

8.1 Introduction

This study has shown that systematic data on allotment sites, their sizes and plot numbers is not currently available for Wales.

In 1993, the National Society of Allotment and Leisure Gardeners was funded [Saunders 1993] to conduct a survey in England and Wales to generate information on the characteristics of allotment holders, patterns of allotment use, the allocation process, costs incurred by allotment holders, facilities on sites and problems identified by those with allotments [Saunders 1993]. The study did not establish the number of sites or plots and Stokes [2002] estimated that there were 500 allotment sites, with 15,000 plot holders within Wales and 180 Welsh allotment societies with a total membership of over 4,000 people, represented by the National Society of Allotment and Leisure Gardeners. Stokes [2002] added 'the estimate was based on population multiplied by average provision for England - it was not very scientific - but the best we could do'.
It is within this framework of uncertainty that the following recommendations are presented.

8.2 Recommendations

The introductory comments above indicate that there is a need for a major commitment to research within Wales to establish the:

- number of allotment sites and plots that currently are located in Wales;

- total number of vacant and available allotment plots in Wales by area,

- quantity and value of vegetable food crop production from present allotment gardening in Wales;

- viability of sales of fresh vegetable food crops within communities adjacent to allotment sites on a co-operative or other community organised enterprise basis;

- ownership, availability and suitability for vegetable food crop production of small vacant cultivable land plots within urban and rural areas for use by community organisations, local individuals and for the teaching of practical growing skills to all cross sections of the community.

8.3 Further work

There is undoubtedly an opportunity and a need for further doctoral and post-doctoral research within Wales to study the schedule set out in section 8.2.

The data gathered for the present study which covers so many aspects of vegetable food crop production criteria could be used as a starting point by researchers in diverse disciplines without incurring substantial initial data gathering costs.

Further work in the area of benchmarking using diverse methods of analysis could improve productivity levels by encouraging and advising positive procedures rather than the 'hit and miss' growing methods at present practiced by some small growers. Disseminating 'good practice' and promoting practical growing skills offer enormous pay-offs to both individuals and communities.

8.3.1 Further practical educational work in hand

An experiment in sustainable food crop production is already being conducted on a small land plot of 3,000m^2 in Trefforest near Pontypridd in South Wales by the GROW project.

The GROW project is a community work experience programme to reclaim and regenerate disused allotments and small vacant land plots in the South Wales valleys in order to grow wholesome, chemical-free vegetable food crops that will be shared/purchased/consumed by the community/local schools participating.

The programme uses innovative approaches to learning through work experience and linked learning. GROW seeks to educate, inform and train young people aged 16 years plus in issues of sustainability, to develop their practical skills, their environmental knowledge and to develop applied ICT skills to design, manage and communicate the progress of the project. The young people work in teams with local residents initially to clear the allotment land, design planting schemes with the aid of appropriate 3D and virtual ICT software and digital images, to dig, prepare, sow and grow wholesome food, and will be introduced to honey harvesting from the hives on site. When the allotments are fully operational and generating a supply of chemical free produce, the teams of young people will set up as a mini enterprises businesses to sell their produce on allotment produce stalls and to their school canteens. The selling of the produce will be supported with a web site and PowerPoint presentation, images generated by a digital camera, a video camera on site and applied ICT technology.

GROW is supported by Pontypridd Town Council with the donation of rent free land and fencing together with a cash donation. The New Opportunities Fund has provided toilets and shelter facilities together with materials for car parking and footpath construction. The Rhondda Cynon Taff Education Authority has made a cash donation to fund land clearance and other ancillary needs. The Princes Trust also assisted with payment for land care. Tools have been purchased with help from the Eco-Ambassadors Project. Seeds have been donated by an organic company Chiltern Seeds of Cumbria. Academic staff and some students from the University of Glamorgan provide time and physical labour.

The GROW Project has involved the participation of local school students aged 16 years and older studying the Welsh Baccalaureate Qualification in a trial approved by the Welsh Assembly Government. Eighteen students took part and fourteen were successful in gaining the Baccalaureate qualification during the first year of operations. Community organisations for various physically impaired and disenfranchised groups have shown interest in the trial and one school for children and teenagers with specific learning difficulties is at present actively involved with the project.

The GROW Project demonstrates to students how to design, plan and manage a vegetable food crop production project within a community setting. Additionally the project teaches the involved students how best to use crops harvested in organic food preparation. It is hoped that this practical approach will improve attitudes, understanding and outlooks, to nutrition knowledge and healthy eating and individual well-being.

Further funding is being sought from various sources and negotiations are ongoing for contractual arrangements with the local authority involving composting and other localisation initiatives to financially support the GROW Project.

Projects such as this offer immediate pay-offs to the local community but also in the longer run may contribute to changing attitudes, expectations and lifestyle in communities across Wales and beyond.

CHAPTER 9

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APPENDIX 1

ORGANIC REGULATIONS AND REGISTRATION BODIES

Appendix 1 Organic Regulations and Registration Bodies

European Regulation 2091/91 (EN45011 & ISO65)

The Regulation 2092/91 requires that all approved certification bodies inspecting and certifying organic products must operate to EN45011 or its international equivalent ISO65. This European Norm or International Standard has established 'Criteria for Bodies Operating Product Certification' and specifies the procedures by which they must operate.

Definition European Norm (EN 45011).

EN45011 is a European Norm which contains provisions relating to the structure of inspection/certification bodies & requires for example that their certification decisions shall be free of influence from commercial considerations. As a consequence, and in order to achieve a "level playing field", all imports of produce from outside the EC for sale as O must also be shown to be certified by bodies complying with EN45011, or its international equivalent, ISIO65. Importers are therefore to provide evidence showing that such compliance exists. UKROFS is not able to authorise any imports involving third country inspection bodies which are unable to demonstrate compliance to EN45011/ISO 65 in line with one of the options set out in Commission document 7607/V1/97 rev.3.

Registration Bodies

United Kingdom Register of Organic Food Standards (UKROFS)

The mission of UKROFS is to ensure that produce grown and sold in the United Kingdom as "organic" conforms to the standards established by UKROFS in implementing European Union legislation described above. UKROFS does this by accrediting, and supervising the work of, private sector organic certification bodies and by authorising the importation of organic produce from countries outside the EU. UKROFS will deal fairly and impartially with all stakeholders in the production of organic food.

UKROFS stakeholders are:

Consumers of organic products.

Retailers, wholesalers, importers and others in the distribution chain.

Farmers, growers and processors of food and agricultural products to be sold as organic.

Certifiers of organic products.

The Department of Environment, Food and Rural Affairs and the Devolved Administrations.

UKROFS consists of a Board appointed by Secretary of State at the Department of Environment, Food and Rural Affairs in consultation with the devolved administrations. To assist it in its work, the Board has appointed Committees dealing with certification, research and development, and technical issues. Members of these Committees, each of which is chaired by a member of the Board of UKROFS, are drawn widely from relevant interests.

Soil Association

As the oldest and probably best known body now licensed by UKROFS Amended [2001] the SA existed before the advent of UK entry into the EU and prior to any UK legislation for organic certification.

- SA Certification is the UK's largest organic certification body
- Established in 1973, SA now certifies 80% of all organic products sold in the UK
- SA Certification provides organic certification of the highest integrity to all sectors of the organic market (food, farms, textiles, health and beauty care, restaurants and even timber)
- SA currently certify over 4,000 organic farms and businesses of all shapes and sizes
- SA is a fully owned trading company of the Soil Association charity
- SA is the only certification body linked to a charity devoted to promoting organic food and farming
- Once certified (licensed) with SA Certification 'licensees' can use the Soil Association symbol. Consumers recognise the symbol as the ultimate mark of organic integrity.

It was not until 1987 that HM Govt established UKROFS to provide baseline organic standards and to approve and monitor the work of organic certification bodies. The three primary aims of the main organic registration body, SA are as follows: -

- Healthy soil,
- healthy food,
- healthy people.

Organic Farmers and Growers Ltd

Organic Farmers & Growers Ltd is one of a number of certification bodies accredited by Defra and is approved to inspect organic production and processing in the UK. OF&G has its national headquarters in Shrewsbury, Shropshire, and operates across Great Britain and Northern Ireland, as well as the Isle of Man and the Channel Islands. Organic Farmers & Growers (OFG) Ltd started as a marketing co-operative in the 1970's and later developed exclusively into a certification body, it claims to be the second largest certification body within the UK [OFG 2000].

Whilst working within the UK and EU Regulations, OF&G prides itself on adopting a practical and realistic approach to organic production and the implementation of the Regulations - an approach which has attracted a number of the more commercially minded and hands-on producers to its ranks. OF&G has established its procedures to comply with the requirements of EN45011 & ISO65 and has been audited by DEFRA to confirm equivalence.

- Operators registered with OF&G enjoy the following benefits:
- Defra-approved certification.
- Access to experienced certification staff to guide you through the complexities of the certification procedures and the Regulations.
- Updated Standards, Technical Leaflets and pro forma Record Keeping Sheets.
- A bimonthly newsletter, which keeps members informed on changing certification issues within OF&G and the organic sector as a whole.
- Access to the Directors of OF&G at the Annual General Meeting.
- The use of the OF&G logo to identify the products as organic.

Scottish Organic Producers Association

The aims and objectives of the Scottish Organic Producers Association Ltd, based in Edinburgh, Scottish Organic Producers Association Ltd (SOPEC) [2002] are:

- Strengthening the prosperity and sustainability of members businesses by being the champion of organic food and farming development in Scotland.

The organisation was founded by Scottish producers in 1988 and registered as a charity under the Industrial and Provident Societies Act [SOPEC 2002].

Organic Food Federation

The Organic Food Federation of Dereham Norfolk was formed in 1986 by local farmers, growers, manufacturers and retailers and their objectives are, as follows.

- To ensure that its members maintain high standards in all aspects of organic production and to advise them accordingly.
- To represent members interests as necessary in communicating with governmental, European Union and other institutions.
- To communicate information on organic topics to members.
- To act as focal point for members to establish contact with one another and to meet as appropriate.
- To provide an official inspection, certification and registration service for the sector as required by EU legislation since January 1993 Organic Food Federation 2002.

Bio-Dynamic Agricultural Association of Great Britain

Bio-Dynamic Agricultural Association of Great Britain (BDAA) is an international organisation, with UK administration conducted from Gloucestershire BDAA [2002]. Established in the UK in 1929, BDAA aims to promote bio-dynamic farming and gardening under the Demeter Certified Trademark fully recognised by UKROFS BDAA newsletter [2001].

Irish Organic Farmers and Growers Ltd

Irish Organic Farmers & Growers Association Ltd (IOFGA) based in the Irish Republic, also operates in Northern Ireland under UKROFS Regulations IOFGA [2002]. It was founded in 1981 by six growers as an organic growers association and later incorporated farmers and associate members including consumers and environmentalists. A voluntary organisation, it aims to promote organic methods in growing and processing food and producing industrial products e.g. soil compost [IOFGA 2002]. IOFGA is the largest organic association in Ireland [IOFGA newsletter 2002].

Organic Trust Ltd

Organic Trust Ltd, based in Ireland was initiated in 1991, and also operates in Northern Ireland, which is a non-profit-making organisation, it is registered by the Department of Agriculture and Food for the Inspection and Certification of Organic producers and processors in Ireland [Ireland Organic Standards 2001 Edition].

Non-Organic Registration

The Wholesome Food Association (WFA)

The criteria for registration as an organic producer under the UKROFS scheme include limitations of land area [UKROFS 2002] and the lower holding limit is one Ha and the higher 300 Ha [Ministry of Agriculture Fisheries and Food (MAFF) Organic Farm Standards (OFS) [1999] and DEFRA (UKROFS) 2002]. The exclusion of growers cultivating small areas for vegetable production has been contributory to the formation of the Wholesome Food Association (WFA). Affiliated membership of WFA in the UK binds members to a pledge of organic growing methodology for produce that cannot be described and sold as organic [WFA 2002]. Producers are required to observe strict regulations parallel to those of UKROFS concerning soil care and use of natural cultivation methods [WFA 2002]. Member's holdings and produce are subjected to random testing to ensure compliance [Chandler 2002]. As at 30th October 2002, the membership of WFA in Wales is recorded as 57 people and for 2004 as 17 people [Chandler 2002 and WFA 2004]. WFA Membership in Wales October 2002 is detailed in Table 3.2 and for December 2004 in Table 3.3 below.

The purposes of the WFA are as follows [WFA 2005]

- Promote food production by sustainable, non-polluting methods using a 'local symbol' scheme.
- To educate people about the health, social and economic benefits of eating fresh, locally grown, wholesome food.
- To help to rebuild and renew local economies and communities by encouraging people to produce and purchase food locally.

The aims of WFA are as follows [WFA 2005]

- Support full spirit of natural, chemical free food production.
-

- Encourage and enable small-scale producers to market produce locally, thus reducing food miles.
- Encourage crop rotation, composting, green manures and companion planting.
- Encourage direct contact between consumers and producers.
- Encourage local trading, freshness, re-cycling, training and knowledge exchange. preservation of wildlife and conservation of the environment.
- Encourage diversity and experimentation in a range of safe and healthy production methods to suit local conditions.
- Administer an open gate policy, by which people who buy WFA produce can visit producers' premises to see how their food is grown.
- Encourage the use of heritage seeds and the use of rare breeds.
- Integrate with Local Economic Trading Schemes (LETS) and Community Supported Agriculture (CSA) schemes WFA [2002].

The WFA, or perhaps a body especially formed on similar lines, could be an ideal driver pursuant of affiliated localised VFC growers within schools and communities.

WFA Membership in Wales 2002. Source WFA 2005.

COUNTY.	WFA MEMBERS (GROWERS)(
ANGLESEY	**2**
CARMARTHEN.	**6**
CERREDIGION	**7**
DENBY	**2**
DUFFYD	**2**
GLAMORGAN	**2**
GWYNDD	**3**
POWYS	**30 [includes Brecknockshire and Montgomoryshire]**
SWANSEA	**3**
TOTAL.	**57**

WFA Membership in Wales 2004. Source WFA 2005.

COUNTY.	**WFA MEMBERS (GROWERS)**
ANGLESEY	**0**
CARMARTHEN.	**4**
CERREDIGION	**1**
DENBY	**0**
DUFFYD	**0**
GLAMORGAN	**2**
GWYNDD	**3**
POWYS	**6 [includes Brecknockshire and Montgomoryshire]**
MONMOUTH	**1**
TOTAL.	**17**

Number of Organic Farmers & Growers UK Source DEFRA 2002

Country	Farmers & Growers	Processors &/or Importers	*Total*
England	**2611**	**1665**	**4276**
Scotland	**694**	**142**	**836**
WALES	**609**	**99**	**708**
Northern Ireland	**135**	**40**	**175**
TOTAL	**4049**	**1946**	**5995**

Key to Table (below) of Sector Bodies for Organic Registration

IOFGA. Irish Organic Farmers & Growers Association.

OFF. Organic Food Federation.

OFG. Organic Farmers & Growers.

SA Ltd. Soil Association Limited.

SOPA. Scottish Organic Producers Association.

OTL. Organic Trust Ltd.

CMI *Check Mate International (USA & UK).*

UKROFS. United Kingdom Register of Organic Food Standards

Sector Body Registrations of Organic Growers Source DEFRA 2002

SECTOR BODY	FARMERS & GROWERS	PROCESSORS / MPORTERS	TOTAL
BDAA	103	53	156
IOFGA	10	6	16
OFF	115	226	341
OFG	944	212	1156
SA Ltd	2305	1438	3743
SOPA	557	0	557
OTL	1	1	2
Cmi	5	7	12
UKROFS	9	3	12
TOTAL	4049	1946	5995

Table below illustrates the number of Hs under conversion for Organic use and registered as in use, detailed for each sector body and UK principality as at September 2002.

The number of Hectares under organic conversion. Source DEFRA 2002

SECTOR BODY	YEAR 1	YEAR 2	O	TOTAL
BDAA	152	395	1954	2501
IOFGA	11	19	247	277
OFF	637	838	2221	3696
OFG	18442	20788	79238	118468
SA Ltd	33393	44272	124733	202398
SOPA	58981	61720	250904	371605
OTL	0	0	17	17
Cmi	54	1	32	87
UKROFS	150	123	557	830
TOTAL	111820	128156	459903	699879
COUNTRY	*YEAR 1*	*YEAR 2*	*O*	*TOTAL*
ENGLAND	*39723*	*45824*	*154510*	*240057*
SCOTLAND	*63892*	*67838*	*264412*	*396142*
WALES	*7794*	*10087*	*38740*	*56621*
NORTHERN IRELAND	*411*	*4407*	*2241*	*7059*
TOTAL	111820	128156	459903	699879

APPENDIX 2 EMAIL GEOFF STOKES 14TH JUNE 2004

From: Geoff Stokes [mailto:Geoff@nsalg.org.uk]
Sent: 14 June 2004 10:35
To: Cook R (SoTech - B&NE)
Subject: RE: Wales 2002[Scanned]

Hi The 500 allotment sites and 15,000 plot holders was an estimate based on population **X** average provision for England. Not very scientific I know but the best we could do.

Regards
Geoff Stokes

----Original Message-----
From: Cook R (SoTech - B&NE) [mailto:rcook@glam.ac.uk]
Posted At: 09 June 2004 12:12
Posted To: natsoc
Conversation: Wales 2002
Subject: Wales 2002[Scanned]

Hello,
During research I have somewhere picked up the following information:-Stokes [2002], indicates that there are 500 allotment sites, with 15,000 plot holders within the Principality of Wales and 180 localised Welsh allotment societies with a total membership of over 4,000 people, represented by NSALG. Can you tell me where I found it!!? It is a thesis reference gone astray. Thanks.

Regards Robin Cook

APPENDIX 3

PILOT QUESTIONNAIRE

Appendix 3 Pilot Questionnaire

PILOT Structured Interview.

SECTION 1 Reference Date:- ....

Q1. Personal Details

Gender ☐ Male ☐ Female

Q2. Age

Age Group ☐ Under 20 ☐ 20-30 ☐ 30-40 ☐ 40-50 ☐ 50-60 ☐ Over 60

Grower Status ☐ Single Grower ☐ Allied to other growers

SECTION 2 Land holding

Q3. Land Status

Tenure ☐ Freehold ☐ Leasehold

Q4. Land area

Hectares ☐ <0.5 Hectares ☐ 0.5-1 Hectare ☐ 1-2 Hectare ☐ 2-3 Hectai

SECTION 3 Land situation

Q5. Boundaries ☐ Enclosed by Hedge ☐ Walled garden ☐ Fenced

Q6. Access

Entry to land ☐ Private ☐ Public ☐ Holders

Q7. Water Supply

Source ☐ River ☐ Stream ☐ Well ☐ Spring
☐ Butts ☐ Mains ☐ Mains Metred

Q8. Water Useage

Enter Litres used ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY
☐ A ☐ S ☐ O ☐ N ☐ D ☐ Don't Know

PILOT Structured Interview.

Q9. Land aspect

Facing
- ☐ South ☐ North ☐ West ☐ East ☐ South West
- ☐ South East ☐ North West ☐ North East ☐ All

Q10. Land relief

Topography
- ☐ Flat ☐ Gentle sloping ☐ Medium slope ☐ Steeply sloping

SECTION 4 Soil Classification

Q11. Soil type
- ☐ Sandy Loam ☐ Loam ☐ Silty Loam ☐ Silty Clay
- ☐ Silty Clay Loam ☐ Sandy Clay Loam ☐ Sandy Clay
- ☐ Clay ☐ Silt ☐ Sandy ☐ Clay Loam

:-

Q12. Drainage
- ☐ Dry ☐ Well Drained ☐ Waterlogged ☐ Moist
- ☐ Land Drain Assisted ☐ No Artificial Land Drainage ☐ Soakaway

Q13. Soil Horizons
- ☐ Well Developed ☐ Clear ☐ Poorly Developed ☐ Diffused

Q14. Parent Rock
- ☐ Millstone Grit ☐ Limestone ☐ Sandstone ☐ Shales ☐ Blue Pennant

Q15. Soil Tests

Test type
- ☐ Arsenic ☐ Cadmium ☐ Chromium ☐ Copper ☐ Lead
- ☐ Mercury ☐ Nickel ☐ pH Test ☐ None

Q16. Certification

UKROFS Body
- ☐ Soil Association ☐ Organic Farmers & Growers Ltd
- ☐ Bio-Dynamic Agricultural Association ☐ Organic Food Federation
- ☐ Organic Trust Ltd ☐ No Affiliations
- ☐ Wholesome Food Association (Not a UKROFS body but organic methodology)

PILOT Structured Interview.

Q17. Restriction of Certification

☐ Land holding area ☐ Cost ☐ Nearby intensive growing activity

☐ Existing polluterts

Q18. Previous use

☐ Woodland ☐ Intensive Farming ☐ Industrial

☐ Rural ☐ Organic Farming ☐ Greenfield

☐ Moorland ☐ Urban ☐ Suburban

☐ Allotment ☐ Don't Know ☐ Brownfield

Q19. Adjoining/nearby Horticultural land use

Indicate N S E or W)

☐ Organic Dairy ☐ Organic Vegatable ☐ Organic Mixed

☐ Organic Poultry ☐ Organic Pig ☐ Intensive Poultry

☐ Intensive monoculture ☐ Intensive Dairy ☐ Intensive Vegetable

☐ Intensive mixed ☐ Intensive Pig ☐ Set aside

☐ Integrated Crop Management Cereal ☐ Silviculture

☐ Integrated Crop Management Mixed Arable

Section 5 Pest & Disease Control

Q20. What pest & disease control methods are used(natural)

☐ Crop Rotation ☐ Resistent Varieties ☐ Companion Planting

☐ Physical barriers ☐ Beer Traps ☐ Frogs

☐ Ladybird ☐ Slow Worms ☐ Hedgehogs

Q21. What pest & disease control methods are used (Organic-biological)

☐ Copper Sulphate ☐ Soft soap ☐ Copper oxychloride B

☐ Copper ammonium carbonate ☐ Sulphur

Q22. What pest & disease control methods are used (Inorganic)

☐ Slug Pellets ☐ Pellets in no return traps

☐ Anyother chemicals ☐ Rotenone

PILOT Structured Interview.

Section 6 Nutrients.

Q23. Fertilizer use (Organic) ☐ Green manure ☐ Compost ☐ Fowl manure ☐ Cow Manure

☐ Organic fertilisers (prepared pellets proprietory) ☐ Horse Manure

☐ Liquid organic (prepared proprietory) ☐ Blood & Bonemeal ☐ Fishmeal

Q24. Fertilizers use (Inorganic) ☐ Phosphate ☐ Nitrogen ☐ Potassium

☐ Sulphur

SECTION 7 Land Use

Q25. Present Crop Production

☐ Leaf vegetable ☐ Flowering vegetable ☐ Root crop ☐ Soft Fruit
☐ Arial Fruit ☐ Plants ☐ Flowers ☐ Herbs ☐ Coppice for Fuel
☐ Coppice for craft ☐ Grasses for Craft

Q26. Employees on land

(Enter No each Month plus P Part Time F Full Time ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Enter below total employee per Month ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

Section 8 Crop Production

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Root crop

Q27. Celeriac Crop ☐ Yes ☐ JAN ☐ FEB ☐ MAR ☐ APR ☐ MAY ☐ JUN

☐ JY ☐ AUG ☐ SEPT ☐ OCT ☐ NOV ☐ DEC

☐ Annual Weight Kilos

PILOT Structured Interview.

Q28. Beetroot Crop ☐ Yes ☐ JAN ☐ FEB ☐ MAR ☐ APR ☐ MAY ☐ JUNE
☐ JLY ☐ AUG ☐ SEP ☐ OCT ☐ NOV ☐ DEC
☐ Annual Weight Kilos

Q29. Potato Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JL ☐ AUG ☐ SEP ☐ OCT ☐ NOV ☐ DEC
☐ Annual Weight Kilos

Q30. Carrot Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q31. Swede Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q32. Parsnip Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q33. Turnip Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q34. Celery Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q35. Radish Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

PILOT Structured Interview.

Arial Vegetables

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Q36. Broad Bean Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q37. Runner Bean Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q38. Pea Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q39. French Beans ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Flowering Vegetable

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Q40. Cauli Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q41. Squash Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Crop Kilos

PILOT Structured Interview.

Q42. Marrow Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Crop Kilos

Q43. Asparagus Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q44. Courgette Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q45. Cucumber Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N
☐ Annual Weight Kilos

Q46. Pumpkin Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Leaf vegetable

Q47. Spinach Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q48. Broccoli Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q49. Sprout Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

PILOT Structured Interview.

Q50. Kale Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q51. Cabbage Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
Inc: All Varieties ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q52. Lettuce ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
Inc: All Varieties ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

BULBOUS VEG:

Q53. White Onion ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q54. Red Onion Crop ☐ Yes ☐ J ☐ M ☐ A ☐ F ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q55. Leek Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q56. Spring Onion Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

PILOT Structured Interview.

Q57. Garlic Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						

SOFT FRUIT

Q58. Strawberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q59. Raspberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q60. Gooseberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q61. Currant Crop	☐ Yes	☐ J	☐ F	☐ M	☐ M	☐ J	
(Inc: Red, Black & White)	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q62. Rhubarb Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q63. Tomato Crop	☐ Yes	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M
(Inc: all Varieties)	☐ J	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D
	☐ Annual Weight Kilos						

PILOT Structured Interview.

Q64. Vine Crop (Inc: all Varieties) ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

ARIAL FRUIT

Q65. Eating Apple Crop ☐ Yes ☐ F ☐ M ☐ J ☐ A ☐ M ☐ J

(Inc: all Varieties) ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q66. Cooking Apple Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

(Inc all Varieties) ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q67. Pear Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Inc all Varieties) ☐ Annual Weight Kilos

Q68. Plum Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Inc all Varieties) ☐ Annual Weight Kilos

Q69. Damson Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q70. Cherry Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

PILOT Structured Interview.

HERBS

Q71. Thyme Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q72. Parsley Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q73. Rosemary Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q74. Coriander Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q75. Chive Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q76. Sage Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q77. Other Herbs ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
(Total all Varieties) ☐ Annual Weight Kilos

PILOT Structured Interview.

FLOWERS

Q78. Daffodil Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number(Average Bunch 10 Blooms)

Q79. Carnation Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q80. Pink Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Average Bunch Number (10 Blooms to Bunch)

Q81. Tulip Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q82. Dry Varieties
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q83. Other Varieties
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ average Bunch number (10 Blooms to Bunch)

PLANTS/ BULBS

Q84. Bulb Sales
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Annual Crop Kilos

PILOT Structured Interview.

Q85. Bedding Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Approx Annual Number of Plants

Q86. House Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Approximate Annual Number of Plants

Q87. Other Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Inc: Tomato/Runner Bean WHY) ☐ Total all Varieties

CRAFT GOODS

Q88. Grasses ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(All Varieties) ☐ Annual Monetary Value £

Q89. Willow ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ N ☐ D

☐ Total Monetary Value £

Q90. Hazel
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Monetary Value £

Q91. Other Craft Goods
☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Specify__________ Add Annual Monetary Value £

PILOT Structured Interview.

Q92. Local Varieties

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Flower, Veg or Fruit) ☐ Distinct Local Variety of any Crop Specify______ Annual Monetary Value £

SECTION 9 CLIMATE

Q93. Precipitation ☐ Average Rainfall per year contour <10 millimetres (mms) per year

☐ 0-50 mms per year ☐ 50-80 mms per year ☐ More - Specify

☐ Not Known

Q94. Temperature ☐ Enter Month & Mean Monthly Temp C ☐ Not Taken

APPENDIX 4

GROWER QUESTIONNAIRE

Appendix 4 Growers Questionnaire

Growers Structured Interview

SECTION 1 Reference Date: - ....

Q1. Personal Details

Gender ☐ Male ☐ Female

Q2. Age

Age Group ☐ Under 20 ☐ 20-30 ☐ 30-40 ☐ 40-50 ☐ 50-60 ☐ Over 60

Grower Status ☐ Single Grower ☐ Allied with other Growers

SECTION 2 Land holding

Q3. Land Status

Tenure ☐ Freehold ☐ Leasehold ☐ Allotment

Q4. Land area

Hectares ☐ <0.5 Hectares ☐ 0.5-1 Hectare ☐ 1-2 Hectares ☐ 2-3 Hectares

SECTION 3 Land situation

Q5. Boundaries ☐ Enclosed by Hedge ☐ Walled Garden ☐ Fenced

Q6. Access

Entry to land ☐ Private ☐ Public ☐ Holders

Q7. Water Supply

Source ☐ River ☐ Stream ☐ Well ☐ Spring

☐ Butts ☐ Mains ☐ Mains Metred

Q8. Water Useage

Enter Litres used

☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY

☐ A ☐ S ☐ O ☐ N ☐ D ☐ Don't Know

Growers Structured Interview.

Q9. Land aspect

Facing

☐ South ☐ North ☐ West ☐ East ☐ South West

☐ South East ☐ North West ☐ North East ☐ All

Q10. Land relief

Topography ☐ Flat ☐ Gentle sloping ☐ Medium slope ☐ Steeply sloping

SECTION 4 Soil Classification

Q11. Soil type ☐ Sandy Loam ☐ Loam ☐ Silty Loam ☐ Silty Clay

☐ Silty Clay Loam ☐ Sandy Clay Loam ☐ Sandy Clay

☐ Clay ☐ Silt ☐ Sandy ☐ Clay Loam

Q12. Drainage ☐ Dry ☐ Well Drained ☐ Waterlogged ☐ Moist

☐ Land Drain Assisted ☐ No Artificial Land Drainage ☐ Soakaway

Q13. Soil Horizons ☐ Well Developed ☐ Clear ☐ Poorly Developed ☐ Diffused

Q14. Parent Rock ☐ Millstone Grit ☐ Limestone ☐ Sandstone ☐ Shales ☐ Blue Pennant

Q15. Soil Tests

Test type

☐ Arsenic ☐ Cadmium ☐ Chromium ☐ Copper ☐ Lead

☐ Mercury ☐ Nickel ☐ pH Test ☐ None

Q16. Certification

UKROFS Body ☐ Soil Association ☐ Organic Farmers & Growers Ltd

☐ Bio-Dynamic Agricultural Association ☐ Organic Food Federation

☐ Organic Trust Ltd ☐ No Affiliations ☐ Allotment Association

☐ Wholesome Food Association (Not a UKROFS body but organic methodology)

Q17. Restriction of Certification	☐ Land holding area	☐ Cost	☐ Nearby intensive growing activity
	☐ Existing pollutents		
Q18. Previous use	☐ Woodland	☐ Intensive Farming	☐ Industrial
	☐ Rural	☐ Organic Farming	☐ Greenfield
	☐ Moorland	☐ Urban	☐ Suburban
	☐ Allotment	☐ Brownfield	☐ Don't Know
Q19. Adjoining/nearby Horticultural land use			
Indicate N S E or W)	☐ Organic Dairy	☐ Organic Vegatable	☐ Organic Mixed
	☐ Organic Poultry	☐ Organic Pig	☐ Intensive Poultry
	☐ Intensive monoculture	☐ Intensive Dairy	☐ Intensive Vegetable
	☐ Intensive mixed	☐ Intensive Pig	☐ Set aside
	☐ Integrated Crop Management Cereal	☐ Silviculture	
	☐ Integrated Crop Management Mixed Arable	☐ Sheep	

Section 5 Pest & Disease Control

Q20. What pest & disease control methods are used (natural)	☐ Crop Rotation	☐ Resistent Varieties	☐ Companion Planting
	☐ Physical barriers	☐ Beer Traps	☐ Frogs
	☐ Ladybird	☐ Slow Worms	☐ Hedgehogs
Q21. What pest & disease control methods are used (Organic-biological)	☐ Copper Sulphate	☐ Soft soap	☐ Copper oxychloride B
	☐ Copper ammonium carbonate		☐ Sulphur
Q22. What pest & disease control methods are used (Inorganic)	☐ Slug Pellets	☐ Pellets in no return traps	
	☐ Any other chemicals	☐ Rotenone	

Growers Structured Interview

Section 6 Nutrients.

Q23. Fertilizer use (Organic)

☐ Green manure ☐ Compost ☐ Fowl manure ☐ Cow Manure

☐ Organic fertilisers (prepared pellets proprietory) ☐ Horse Manure

☐ Liquid organic (prepared proprietory) ☐ Blood & Bonemeal ☐ Fishmeal

Q24. Fertilizers use (Inorganic)

☐ Phosphate ☐ Nitrogen ☐ Potassium

☐ Sulphur

SECTION 7 Land Use

Q25. Present Crop Production

☐ Leaf vegetable ☐ Flowering vegetable ☐ Root crop ☐ Soft Fruit
☐ Arial Fruit ☐ Plants ☐ Flowers ☐ Herbs ☐ Coppice for Fuel
☐ Coppice for craft ☐ Grasses for Craft

Q26. Employees on land

(Enter No each Month plus P Part Time F Full Time

☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Enter below total employee per Month

☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

Section 8 Crop Production

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Root crop

Q27. Celeriac Crop ☐ Yes ☐ JAN ☐ FEB ☐ MAR ☐ APR ☐ MAY ☐ JUN

☐ JY ☐ AUG ☐ SEPT ☐ OCT ☐ NOV ☐ DEC

☐ Annual Weight Kilos

Growers Structured Interview.

Q28. Beetroot Crop
☐ Yes ☐ JAN ☐ FEB ☐ MAR ☐ APR ☐ MAY ☐ JUNE
☐ JLY ☐ AUG ☐ SEP ☐ OCT ☐ NOV ☐ DEC
☐ Annual Weight Kilos

Q29. Potato Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JL ☐ AUG ☐ SEP ☐ OCT ☐ NOV ☐ DEC
☐ Annual Weight Kilos

Q30. Carrot Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q31. Swede Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q32. Parsnip Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q33. Turnip Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q34. Celery Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q35. Radish Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Growers Structured Interview.

Arial Vegetables

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Q36. Broad Bean Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q37. Runner Bean Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q38. Pea Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q39. French Beans ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Flowering Vegetable

Enter P for Plant & C for Crop each month.
and approx annual weight of Crop

Q40. Cauli Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q41. Squash Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Crop Kilos

Growers Structured Interview.

Q42. Marrow Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ Annual Weight Kilos ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

Q43. Asparagus Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q44. Courgette Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q45. Cucumber Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N

☐ Annual Weight Kilos

Q46. Pumpkin Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Leaf vegetable

Q47. Spinach Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q48. Broccoli Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q49. Sprout Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Growers Structured Interview.

Q50. Kale Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q51. Cabbage Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
Inc: All Varieties ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q52. Lettuce ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
Inc: All Varieties ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

BULBOUS VEG:

Q53. White Onion ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q54. Red Onion Crop ☐ Yes ☐ J ☐ M ☐ A ☐ F ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q55. Leek Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Q56. Spring Onion Crop ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Weight Kilos

Growers Structured Interview.

Q57. Garlic Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						

SOFT FRUIT

Q58. Strawberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q59. Raspberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q60. Gooseberry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q61. Currant Crop	☐ Yes	☐ J	☐ F	☐ M	☐ M	☐ J	
(Inc: Red, Black & White)	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q62. Rhubarb Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						

Q63. Tomato Crop	☐ Yes	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M
(Inc: all Varieties)	☐ J	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D
	☐ Annual Weight Kilos						

Growers Structured Interview.

Q64. Vine Crop (Inc: all Varieties)	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q65. Eating Apple Crop	☐ Yes	☐ F	☐ M	☐ J	☐ A	☐ M	☐ J
(Inc: all Varieties)	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q66. Cooking Apple Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
(Inc all Varieties)	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q67. Pear Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
(Inc all Varieties)	☐ Annual Weight Kilos						
Q68. Plum Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
(Inc all Varieties)	☐ Annual Weight Kilos						
Q69. Damson Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						
Q70. Cherry Crop	☐ Yes	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J
	☐ JY	☐ A	☐ S	☐ O	☐ N	☐ D	
	☐ Annual Weight Kilos						

HERBS

Q71. Thyme Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q72. Parsley Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q73. Rosemary Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q74. Coriander Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q75. Chive Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q76. Sage Crop

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Weight Kilos

Q77. Other Herbs

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Annual Weight Kilos

FLOWERS

Q78. Daffodil Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number(Average Bunch 10 Blooms)

Q79. Carnation Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q80. Pink Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Average Bunch Number (10 Blooms to Bunch)

Q81. Tulip Crop
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q82. Dry Varieties
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ Annual Bunch Number (Average Bunch 10 Blooms)

Q83. Other Varieties
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D
☐ average Bunch number (10 Blooms to Bunch)

PLANTS/BULBS

Q84. Bulb Sales
☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J
☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Annual Crop Kilos

Growers Structured Interview.

Q85. Bedding Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Approx Annual Number of Plants

Q86. House Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Total all Varieties) ☐ Approximate Annual Number of Plants

Q87. Other Plants ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Inc: Tomato/Runner Bean WHY) ☐ Total all Varieties

CRAFT GOODS

Q88. Grasses ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(All Varieties) ☐ Annual Monetary Value £

Q89. Willow ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ N ☐ D

☐ Total Monetary Value £

Q90. Hazel ☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Annual Monetary Value £

Q91. Other Craft Goods ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J ☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

☐ Specify ____________ Add Annual Monetary Value £

Growers Structural Interview.

Q92. Local Varieties

☐ Yes ☐ J ☐ F ☐ M ☐ A ☐ M ☐ J

☐ JY ☐ A ☐ S ☐ O ☐ N ☐ D

(Flower, Veg or Fruit) ☐ Distinct Local Variety of any Crop Specify _______ Annual Monetary Value £

Q93. Honey ☐ Yes ☐ No ☐ Weight Annual Crop Kilogrammes

SECTION 9 CLIMATE

Q94. Precipitation ☐ Average Rainfall per year contour <10 millimetres (mms) per year

☐ 0-50 mms per year ☐ 50-80 mms per year ☐ More - Specify

☐ Not Known

Q95. Temperature ☐ Enter Month & Mean Monthly Temp C ☐ Not taken

Growers Structured Interview.

Section 10 Business Detail

Capital Costs

Q1. Year of Frehold Purchase ________

Q2. Freehold/Leasehold Cost per Hectare £ ________

Q3. Lease Period ________

Q4. Annual rent £ ________

Q5. Tools & Equipment £ ________

Q6. Tools & Equipment (Annual) £ ________

Q7. Waste £ ________

Wage & Services CostsCosts

(Enter annual cost)

Q8. Q 115 All Wage Costs ☐ Part Time £ ☐ Full Time £

£ ________

Q9. Rates

Q10. Insurances £ ________

Produce Input

Q11. Approx Annual seed save ☐ £10 -£20 ☐ £20 - £ 30 ☐ £30 - £ 40 ☐ More - Please specify.

Q12. Organic Seed,Bulb,Serts,Plants £ ________

Q13. Standard Seed,Bulb,Serts,Plants £ ________

Q14. Organic Fertilizers £ ________

£

Q15. Inorganic Fertilizers ________

Sales Income (Enter monthly income)

Q16. Root Vegetables	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q17. Arial Vegetables	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q18. Flowering vegetables	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q19. Leaf Vegetables	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q20. Arial Fruit	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q21. Bulbous Vegetables	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q22. Herbs	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q23. Flowers	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q24. Plants	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q25. Soft Fruits	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		

Growers Structured Interview.

Q26. Grasses	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q27. Coppice	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q28. Open Days	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		
Q29. Courses	☐ J	☐ F	☐ M	☐ A	☐ M	☐ J	☐ JY
	☐ A	☐ S	☐ O	☐ N	☐ D		

Marketing

Q30. Distribution Methods

☐ Farmers Mkt ☐ Box Scheme ☐ Direct to Restaurants

☐ Cooperative ☐ Farm Gate ☐ Direct to hotels

☐ Direct to Shops for re-sale ☐ Others-Specify

Q31. Any other Income-Specify ______________

£ (Annual)

Q32. Perecentage Turnover Immediate Payment (Specify)

☐ Farmers Mkt ☐ Box Scheme ☐ Direct to Restaurants

☐ Direct to Hotels ☐ Direct to Shops for Retail ☐ Cooperative

☐ Farm Gate ☐ Others

Q33. Percentage Turnover Credit Granted

☐ Farmers Mkt ☐ Box Scheme ☐ Direct to Restaurants

☐ Direct to Hotels ☐ Direct to Shops for Resale ☐ Cooperative

☐ Farm Gate ☐ Others (Specify)

I understand that the information I have given is strictly confidential and will not be in the public domair

The content will be used for academic research purposes by Robin Cook at the University of Glamorgar

Research findings will be published in academic journals with anonimity.

APPENDIX 5

SOIL ASSOCIATION REGISTERED

GROWERS/PRODUCERS WALES

Appendix 5 Soil association registered growers/producers Wales

Soil Association Certification Limited

UK Organic Producers

listed by County and last name

Contact	Phone	Fax	Licence No	Farm Size
Anglesey				
Hooton, Andrew, Mr	01248 430344	01248 430322	G5455	75.7 ha
	Gwydryn Hir, Brynsiencyn, Anglesey, LL61 6HQ			
Licenced for Organic	Grass & Forage, Vegetables			
Non-Organic	Topfruit - Dessert & Culinary, Potatoes, Poultry - Eggs, Farm Shop/Retail Sales, Poultry - Meat, Herbs, Grass & Forage, Pigs, Plant Raising, Soft Fruit, Sheep, Greenhouse Crops			
Parker, Mike & Gillian	01248 852316		G5830	3.1 ha
	Plas Llanfair, Ynys Mon, Anglesey, LL74 8NU mike@plasllanfair.freeserve.co.uk			
Licenced for Organic	Plant Raising, Greenhouse Crops, Soft Fruit, Grass & Forage, Vegetables, Topfruit - Dessert & Culinary, Poultry - Eggs			
Robertson, J	01248 421661		G5829	27.4 ha
	Tyddyn Adda, Llanddaniel, Gaerwen, Anglesey, LL60 6HB digweed50@hotmail.com			
Licenced for Organic	Greenhouse Crops, Grass & Forage, Mixed Vegetables, Flowers (Cut), Apples (Culinary), Cherries, Plums, Soft Fruit (Berries/Currants), Apples (Dessert), Beef (Calves), Sheep- Store Lambs			
Non-Organic	Honey			
Non Organic	Poultry - Eggs			
Converted Breed Stock	Beef Cattle, Sheep			
Cardiff				
Maurice, Leighton, Mr	01446 772964		G6003	1 ha
	Lake Farm Barns, St Athan Road, Cowbridge, Cardiff, CF71 7HY			
Licenced for Organic	Land, Plant Raising			
Conversion	Herbs			
Carmarthenshire				
Brill, R, Mr	01570 493417		G7704	2.4 ha
	Cwmcer Dinen Farm, Cwmcer Dinen, Lampeter, Carmarthenshire, SA48 8JA			
Licenced for Organic	Vegetables, Grass & Forage, Poultry - Eggs			
Non Organic	Dairy Goats/Milk, Dairy Sheep/Milk, Sheep			
Conversion	Top Fruit - Dessert, Soft Fruit			
Burgess, Mr	01558 668613		G4920	25.8 ha
	Pencaemawr, Llanfynydd, Carmarthenshire, SA32 7TR			

Carnell, Cliff & Simon, Messrs	01267-202463		G1600	85.8 ha
	Llystyn Farm, Brechfa, Carmarthen, Carmarthenshire, SA32 7RB			
Licenced for Organic	Mixed Vegetables, Beef (Finished Beef), Cereals (Grain), Grass & Forage, Sheep (Finished Lamb), Beef (Store Cattle)			
Edwards, Joy, Ms	01550 740306	01550 740306	G8453	0.5 ha
	Y Ffatri Madarch, Llangadog, Carmarthenshire, SA19 9HD			
Licenced for Organic	Mushroom Spawn, Mushrooms			
Emberson, Emma, Ms	01437 532570		G7339	16.6 ha
	Ffynnon Samson, Llangolman, Clynderwen, Carmarthenshire, SA66 7QL ffynnon@tiscali.co.uk			
Licenced for Organic	Chicken - Eggs, Grass & Forage, Vegetables			
Ferguson & Mr Stephen Jones, Thelma,	01550 776209	01550 760331	G2946	104.4 ha
	Coleg Elidyr (CCW) Ltd, Rhandirmwyn, Llandovery, Carmarthenshire, SA20 0NL			
Licenced for Organic	Dairy Cattle/Milk, Topfruit - Dessert & Culinary, Greenhouse Crops, Potatoes, Vegetables, Sheep, Soft Fruit, Grass & Forage, Beef Cattle			
Non-Organic	Processing - Meat Products, Pigs, Poultry - Eggs, Processing- Dairy Products			
Non Organic	Grass & Forage			
Conversion	Land			
Fordham, A N G, Mr	01239 851466		G2082	102.5 ha
	Dolgoch, Brogest, Newcastle Emlyn, Carmarthenshire, SA38 9EU			
Licenced for Organic	Grass & Forage, Cereals, Vegetables, Dairy Cattle/Milk, Dairy Calves			
Hallam, Roger, Mr	01558 668088	01558 668088	G2644	30 ha
	Werndolau, Gelli Aur, Carmarthenshire, SA32 8NE mail@organics2go.co.uk			
Licenced for Organic	Topfruit - Dessert & Culinary, Vegetables, Soft Fruit, Grass & Forage			
Hunt, Bob & Carolyn, Mr & Mrs	01559 395662		G5587	24.6 ha
	Vicarage Farm, Llanfihangel-ar-arth, Pencader, Carmarthenshire, SA39 9HZ			
Licenced for Organic	Sheep, Beef Cattle, Grass & Forage, Roots, Cereals			
James, D, Mr & Mrs	01994 241368	01994 241366	J16WW	33.3 ha
	R & D James, Rogerswell, Whitland, Carmarthenshire, SA34 0QY dotandbob@pen-y-lan.fsnet.co.uk			
Licenced for Organic	Beef Cattle, TopFruit - Dessert, Potatoes, Plant Raising, Herbs, Vegetables, Grass & Forage, Soft Fruit, Sheep, Greenhouse Crops			
Non Organic	Woodland			
Kim, Gillian & Jung Woo	01437 563255		G5047	11 ha
	Bryn-onnen Farm, Login, Whitland, Carmarthenshire, SA34 0UY			
Licenced for Organic	Vegetables, Sheep, Grass & Forage			
Smith, G K, Mr	01994 231578		G7380	5.7 ha
	Brynheulog, Plas-y-Gwer, Carmarthen, Carmarthenshire, SA33 4LX			
Licenced for Organic	Grass & Forage, Vegetables			

Wignall, Gary, Mr	01558 669043		G7180	9.4 ha
	Manse Organics, The Manse, Llandeilo, Carmarthenshire, SA19 7TN gary@bitenet.co.uk			
Licenced for Organic	Grass & Forage, Vegetables			
Conversion	Herbs, Top fruit - Dessert & Culinary			

Ceredigion

Allen, Robert, Mr	01970 612114		G3081	1.2 ha
	Mentro Lluest, Llanbadarn Fawr, Aberystwyth, Ceredigion, SY23 3AU mentro.lluest@talk21.com			
Licenced for Organic	Raspberries, Salads, Greenhouse Crops, Mixed Vegetables, Plant Raising, Strawberries, Herbs (Annual), Herbs (Perennial), Flowers (Cut), Apples (Dessert)			
Non Organic	Plant Raising, Ornamental Plants			
Bligh, A, Mr	01545-571344		G758	1 ha
	Drefach Organic Nursery, Aberaeron, Ceredigion, SA44 8JF andyb@ceredigion.gov.uk			
Licenced for Organic	Greenhouse Crops, Grass & Forage			
Carpenter & Twyford, MBP & CA	01545 590687		G4267	4.9 ha
	Ty Gwyn, Llwyn Rhydowen, Llandysul, Ceredigion, SA44 4PX Mike Carpenter<peasants@care4free.net>			
Licenced for Organic	Vegetables, Farm Shop/Retail Sales, Greenhouse Crops, Grass & Forage, Sheep, Soft Fruit			
Crocker, John R, Mr	01974 272218		G2225	8.5 ha
	LLUEST GROWERS, Lluest Y Conscience, Aberystwyth, Ceredigion, SY23 4HE			
Licenced for Organic	Greenhouse Crops, Plant Raising, Grass & Forage, Mixed Vegetables, Soft Fruit (Various), Apples (Dessert), Chicken (Eggs), Apples (Culinary)			
Evans, Paul, Mr	01545 571300		G4269	11 ha
	2 Drefach Cottages, Aberaeron, Ceredigion, SA46 0JR			
Licenced for Organic	Grass & Forage, Vegetables, Potatoes, Greenhouse Crops, Plant Raising			
Ferguson, C, Mrs	01239 851914	01239 851914	G4359	22.7 ha
	Nantgwynfaen, Croeslan, Llandysul, Ceredigion, SA44 4SR			
Licenced for Organic	Cereals, Grass & Forage, Beef Cattle, Pigs, Poultry - Eggs, Dairy Cattle/Milk, Vegetables, Soft Fruit, Topfruit - Dessert & Culinary			
Findlay, Elizabeth, Ms	01974 241543		G1064	10.1 ha
	Nant Clyd, Rhos Y Garth, Aberystwyth, Ceredigion, SY23 4SG liz.findlay@clara.co.uk			
Licenced for Organic	Soft Fruit, Grass & Forage, Sheep, Greenhouse Crops, Poultry - Eggs			
Frost, David, Mr	01974 272364	01974 272364	F05WW	12.7 ha
	Tynyrhelyg, Llanrhystud, Ceredigion, SY23 5EE david.frost@adas.co.uk			
Licenced for Organic	Sheep, Grass & Forage, Potatoes, Vegetables, Soft Fruit			
Guise, DT & JM, Mr & Mrs	01570471432		G4270	3.6 ha
	Rhyd y Gwin, Temple Bar, Lampeter, Ceredigion, SA48 8BQ			

Licenced for Organic	Herbs, Topfruit - Dessert & Culinary, Grass & Forage, Vegetables, Flowers, Sheep, Soft Fruit, Plant Raising, Greenhouse Crops, Poultry - Eggs			
Non Organic	Christmas Trees			
Hearn, Ian, Mr	07811 975869		G7271	8.4 ha
	Trem-y-Gorwell, The Old Barn, Brongest, Ceredigion, SA38 9EX ianhearn@tiscali.co.uk			
Licenced for Organic	Vegetables, Grass & Forage			
Holden, & Mrs RM, Mr PH	01570 493244		H09WW	95.3 ha
	Bwlchwernen Fawr, Llangybi, Lampeter, Ceredigion, SA48 8PS			
Licenced for Organic	Beef Cattle, Vegetables, Cereals, Grass & Forage, Dairy Cattle/Milk, Beef Calves/Stores			
Jacobs, Mr SA & Mrs CC	01239 851261	01239 851261	G7539	18.2 ha
	Broniwan, Rhydlewis, Llandysul, Ceredigion, SA44 5PF b.organic@ouvip.com			
Licenced for Organic	Grass & Forage, Vegetables, Chicken - Eggs, Beef Cattle			
Conversion	Soft Fruit			
King, Chris & Sally, Mr & Mrs	01570 493347		G4388	15.1 ha
	Garthenor, Llanio Road, Tregaron, Ceredigion, SY25 6UR chrisk@garthenor.fsnet.co.uk			
Licenced for Organic	Grass & Forage, Beef Cattle, Sheep, Vegetables, Chicken - Eggs, Wool, Plant Raising, Poultry Rearing, Hops			
Meredith, E S & Miss C, Mrs	01239 654289		G2093	62 ha
	Llety'r Cymro, Llwyndafydd, Llandysul, Ceredigion, SA44 6DD			
Licenced for Organic	Wool, Grass & Forage, Beef Cattle, Sheep, Cereals, Potatoes			
Segger, P, Mr	01570 470529		S04WW	18.4 ha
	Blaen Camel Farm, Cilcennin, Lampeter, Ceredigion, SA48 8DB anne@blaencamel.fsnet.co.uk			
Licenced for Organic	Potatoes, Sheep, Grass & Forage, Greenhouse Crops, Vegetables			
Sumpter, Ian, Mr	01239 851850	01239 851850	G5980	18.1 ha
	Llwyn-yr-eos, Rhydlewis, Llandysul, Ceredigion, SA44 5QU iansumpter@hotmail.com			
Licenced for Organic	Grass & Forage, Vegetables			
Taylor, Brian, Mr	01570 481 025	01570 481 121	G5852	1.9 ha
	Rhydiau, Drefach, Llanybydder, Ceredigion, SA40 9SX brian@rhydiau.fsnet.co.uk			
Licenced for Organic	Soft Fruit, Vegetables, Christmas Trees, Greenhouse Crops			
Walsh, John, Mr	01545 571430		G1940	12.8 ha
	Ty-rhos, Upper Aberarth, Nr Aberaeron, Ceredigion, SA46 0LA			
Licenced for Organic	Grass & Forage, Sheep, Greenhouse Crops, Plant Raising, Vegetables, Herbs			
West, TE & A, Messrs	01570423333		G4271	3.1 ha
	Cil-Yr-Ychain, Cwmann, Lampeter, Ceredigion, SA48 8HD			
Licenced for Organic	Grass & Forage, Vegetables, Topfruit - Dessert & Culinary, Herbs, Plant Raising, Soft Fruit, Potatoes, Greenhouse Crops			

Williams, David Thomas, Mr	01570 422429		G2261	76.9 ha
	G Williams & Son, Dolaugwyrddion Isaf, Lampeter, Ceredigion, SA48 7JR			
Licenced for Organic	Cereals, Sheep, Dairy Cattle/Milk, Grass & Forage, Beef Cattle, Pigs, Soft Fruit, Potatoes			

Denbighshire

Lee, David & Andrea, Mr & Mrs	01690 770345	01690 770180	G6524	25.1 ha
	Hafod Elwy Hall, Bylchau, Denbighshire, LL16 5SP			
Licenced for Organic	Potatoes (Ware), Apples (Culinary), Soft Fruit (Various), Grass & Forage, Greenhouse Crops, Herbs (Annual), Plant Raising, Mixed Vegetables, Beef (Store Cattle), Dairy Cattle (Milk), Pigs (Meat Animals), Chicken (Eggs), Chicken (Table Birds), Sheep (Finished Lamb), Apples (Dessert), Beef (Finished Beef), Herbs (Perennial), Sheep (Store Lambs)			
Non Organic	Woodland			

Flintshire

Robertshaw, Paul, Mr	01352 841000	01352 841031	G4476	73.1 ha
	The Welsh College Of Horticulture, Northop, Mold, Flintshire, CH7 6AA paul_robertshaw@wcoh.ac.uk			
Licenced for Organic	Grass & Forage, Greenhouse Crops, Plant Raising, Vegetables			
Non-Organic	Horses			

Glamorgan

Revill, Edward, Mr	01792 232643		G2504	3.6 ha
	Jade Gate Ltd, 16 Holtsfield, Swansea, Glamorgan, SA3 3AQ			
Licenced for Organic	Vegetables, Greenhouse Crops, Soft Fruit, Plant Raising, Grass & Forage, Topfruit - Dessert & Culinary, Potatoes, Herbs			

Gwynedd

, Michael Langley & Ms Jill Jackson	01766 810915		G6139	5.3 ha
	Tyn Lon Uchaf, Llangybi, Pwllheli, Gwynedd, LL53 6TB mike.langley@ntlworld.com			
Licenced for Organic	Grass & Forage, Potatoes, Vegetables, Herbs, Greenhouse Crops, Topfruit - Dessert & Culinary, Soft Fruit, Plant Raising, Mushrooms, Pigs, Chicken (Eggs)			
Davies, E & L, Mr & Mrs	01678 540249		G7140	89.2 ha
	Cyffdy Farm, Parc, Bala, Gwynedd, LL23 7YW liliandavies@yahoo.co.uk			
Licenced for Organic	Sheep (Breeding Stock), Top Fruit - Dessert, Soft Fruit, Plant Raising, Mixed Vegetables, Potatoes, Legumes, Sheep (Finished Lamb), Pigs (Meat Stock), Chicken (Eggs), Grass & Forage			
Ellis, Richard, Mr	01766 810100	01758 750247	G6875	120.9 ha
	Llithfaen, Pwllheli, Gwynedd, LL53 6NH			
Licenced for Organic	Sheep (Finished Lamb), Grass & Forage, Beef (Store Cattle), Beef (Finished Beef), Mixed Vegetables			
Converted Breed Stock	Beef (Breeding Stock), Beef Cattle, Sheep (Breeding Stock)			
Conversion	Vegetables			
Foreman, Roger, Mr	01407 742293		G5882	3.9 ha
	Ysgubor Bach, Ffordd Cerrig Mawr, Caergeiliog Holyhead, Gwynedd, LL65 3LU			
Licenced for Organic	Plant Raising, Box Scheme, Grass & Forage, Potatoes, Vegetables, Herbs, Topfruit - Dessert & Culinary, Soft Fruit, Chicken (Eggs)			
Kidd, J, Mrs	01766-810545		G08WW	3.7 ha

	Rhosfawr Nurseries. Tyddyn Berth. Rhosfawr. Y-ffor. Pwllheli. Gwynedd. LL53 6YA			
Licenced for Organic	TopFruit - Dessert. Vegetables. Potatoes. Greenhouse Crops. Soft Fruit. Farm Shop/Retail Sales			
Non-Organic	Trees & Shrubs			
Lynas. Val. Mrs	01766 819109		G7096	4.8 ha
	Mur Crusto. Llangybi. Pwllheli. Gwynedd. LL53 6LX val.lynas@ntlworld.com			
Licenced for Organic	Grass & Forage. Herbs. Vegetables. Plant Raising. Greenhouse Crops			
Conversion	Top fruit - Dessert & Culinary. Soft Fruit			
Parry. Ann. Ms	01758 740233	01758 740233	G5424	169 ha
	Gallt y Beren. Rhydyclafdy. Pwllheli. Gwynedd. LL53 7YP			
Licenced for Organic	Cereals. Dairy Cattle/Milk. Grass & Forage. Potatoes			
Non-Organic	Beef Cattle			
Thomas. GO. Mr	01248 600400	01248600400	G4482	329.3 ha
	Blaen y Nant. Nant Ffrancon. Bethesda. Gwynedd. LL57 3DD			
Licenced for Organic	Roots. Beef Cattle. Grass & Forage. Sheep			
Williams. Thomas Gareth. Mr	01248 430355	G2144	40.4	ha
	Porth-Amel Home Farm. Llanedwen. Anglesey. Gwynedd. LL61 6PJ			
Licenced for Organic	Beef Cattle. Sheep. Grass & Forage. Poultry - Eggs. Vegetables. Potatoes. Greenhouse Crops			

Monmouthshire

Bevan. J. Mrs	01873 840247	01873 840247	G4224	105.8 ha
	Great House Farm. Penpergwm. Abergavenny. Monmouthshire. NP7 9UY pwjabevan@aol.com			
Licenced for Organic	Cereals. Dairy Cattle/Milk. Pigs. Beef Calves. Grass & Forage. Vegetables. Sheep			
Boyle. R. Mr	01600 714 529		G1803	16.2 ha
	Carrob Growers. Llangunville. Llanrothal. Monmouthshire. NP25 5QL boyle@carrobgrowers.co.uk			
Licenced for Organic	Vegetables. Soft Fruit. Grass & Forage. Plant Raising. Topfruit - Dessert & Culinary. Top Fruit - Cider Apples			
Non-Organic	Sheep			
Cooper. P M. Mr	01633 400406		G59WW	1.5 ha
	Whitebrook Organic Growers. The Old Rectory. Newport. Monmouthshire. NP26 3AY			
Licenced for Organic	Walnuts. Top fruit - Dessert & Culinary. Soft Fruit. Greenhouse Crops. Vegetables. Plant Raising			
Davies. Robert Emlyn. Mr	01443 839451	01443 839451	G2925	37.2 ha
	Pencoed Fach Farm. Bedwellty. Blackwood. Monmouthshire. NP2 0BQ			
Licenced for Organic	Potatoes. Dairy Cattle/Milk. Grass & Forage. Roots. Beef Cattle			
Non Organic	Beef/Store cattle			
Converted Breed Stock	Converted Breeding Stock/ Cattle			
George. Gerald. Mr	01873 880848		G8498	11 ha
	Upper Pentwyn Farm (part). c/o The Flat. Abergavenny. Monmouthshire. NP7 9DW			

Licenced for Organic	Mixed Vegetables, Herbs (Annual), Greenhouse Crops, Herbs (Potted)				
Watkins, D J, Mr	01981 240266	01981 240266	G4778	195.3	ha
	Maerdy Farm, Grosmont, Abergavenny, Monmouthshire, NP7 8HG D.J.Watkins@ukgateway.net				
Licenced for Organic	Beef /Calves, Beef/Store Cattle, Top Fruit - Cider Apples, Dairy Cattle/Milk, Potatoes, Grass & Forage, Legumes, Roots				
Non-Organic	Sheep, Cereals, Grass & Forage				
Conversion	Grass & Forage, Cereals				
Wood, Adrian, Mr	01291 689253	01291 689253	G1215	12.5	ha
	The Nurtons, Tintern, Chepstow, Monmouthshire, NP16 7NX elsa.adrian@thenurtons.fsnet.co.uk				
Licenced for Organic	Grass & Forage, Plant Raising, TopFruit - Dessert, Herbs, Farm Shop/Retail Sales				

Pembrokeshire

Barnard, KB & JY, Mr & Mrs	01994 241157		G2439	26	ha
	Gorse Farm, Velfrey Road, Whitland, Pembrokeshire, SA34 0QX barnard_kb@yahoo.co.uk				
Licenced for Organic	Vegetables, Beef Cattle, Sheep, Grass & Forage, Wool, Soft Fruit				
Carlisle, A B, Mr	01646-651010		G647	128.5	ha
	Little Pencoed, Lawrenny, Kilgetty, Pembrokeshire, SA68 0PL				
Licenced for Organic	Sheep (Store Lambs), Grass & Forage, Cereals (Grain), Beef (Store Cattle), Dairy Cattle (Milk), Potatoes (Ware), Beef (Finished Beef), Sheep (Finished Lamb)				
Cotton, Huw, Mr	01348 872318		G4272	115.6	ha
	Cilau Ganol, Goodwick, Pembrokeshire, SA64 0HS				
Licenced for Organic	Dairy Cattle (Milk), Grass & Forage, Cereals (Grain), Swedes, Dairy Cattle (Calves), Beef (Store Cattle), Beef (Finished Beef)				
Curphey, M R, Mr	01646 636714		G1460	71.3	ha
	Sandy Haven Farm, St Ishmaels, Haverfordwest, Pembrokeshire, SA62 3DN				
Licenced for Organic	Soft Fruit, Grass & Forage, Potatoes, Vegetables, Cereals				
Non Organic	Woodland				
Dent & Barbara Fredriksson, Nicola	01834 870128	01834 870128	G5767	0.5	ha
	Baldwins Moor, Tenby, Pembrokeshire, SA70 7TY info@celticherbs.co.uk				
Licenced for Organic	Grass & Forage, Herbs (Annual), Herbs (Perennial)				
Elliott, Ian D, Mr	01646 651300	01646 651300	G2400	91	ha
	Cresswell Barn Farm, Cresswell Quay, Kilgetty, Pembrokeshire, SA68 0TH				
Licenced for Organic	Grass & Forage, Vegetables, Cereals, Potatoes				
Evans, W, Mr	01437 720548	01437 720548	G1644	76.7	ha
	D.W & C.M Evans, Caerfai Farm, Haverfordwest, Pembrokeshire, SA62 6QT				
Licenced for Organic	Potatoes, Dairy Cattle/Milk, Grass & Forage, Cereals, Pulses, Beef Calves/Stores, Dairy Youngstock				
Harris, T, Mr	01239 682572		G6592	332.2	ha
	T. G Harris Business, Abercych, Boncath, Pembrokeshire, SA37 0EU tomharris@waitrose.com				

Licenced for Organic — Cereals, Sheep, Beef Cattle, Legumes, Roots, Grass & Forage

Conversion — Land, Grass & Forage

Hicks, Glyn & Ann, Mr & Mrs — 01348 873004 — G5836 — 11 ha

Ffynnonston Organics, Ffynnonston, Fishguard, Pembrokeshire, SA65 9QT
annhicks@waitrose.com

Licenced for Organic — Topfruit - Dessert & Culinary, Soft Fruit, Grass & Forage, Herbs, Plant Raising, Potatoes, Vegetables, Soft Fruit, Flowers

Jenkins, A P M, Mr — 01437 720241 — G2073 — 5.3 ha

Tir Maen Dewi, Rhodiad-Y-Brenin, St Davids, Pembrokeshire, SA62 6PJ

Licenced for Organic — Potatoes, Beef Cattle, Vegetables, Grass & Forage, Plant Raising, Poultry - Eggs

John & Mrs Julia Dadswell — 01437 532474 — G2969 — 3.7 ha

The Old Butchers, Spring Villa, Clynderwen, Pembrokeshire, SA66 7LE

Licenced for Organic — Topfruit - Dessert & Culinary, Soft Fruit, Chicken (Eggs), Potatoes, Vegetables, Grass & Forage, Sheep, Duck (Eggs), Duck (Table birds)

Latter, T R E, Mr — 01348 873315 — G1445 — 75.7 ha

Penrhiw, Goodwick, Pembrokeshire, SA64 0HS
tomlatter@classicfm.net

Licenced for Organic — Cereals, Sheep, Chicken - Eggs, Grass & Forage, Finished beef, Vegetables, Potatoes

Lort-Phillips, O, Mr — 01834 891344 — 01834 891344 — G2685 — 366.5 ha

Lawrenny Farms, Knowles Farm, Kilgetty, Pembrokeshire, SA68 0PX
owenlp@onetel.net.uk

Licenced for Organic — Cereals, Beef Cattle, Dairy Cattle/Milk, Potatoes, Grass & Forage

Non-Organic — Cereals

McDowell, Robert, Mr — 01239 841675 — 01239 841675 — G6287 — 4.7 ha

Growing Heart Workers Coop Ltd, Bwlch-y-Groes, Boncath, Pembrokeshire, SA37 0JY

Licenced for Organic — Apples (Cider), Soft Fruit (Various), Herbs (Perennial), Apples (Dessert), Pears, Plums, Cherries, Greenhouse Crops, Plant Raising, Potatoes (Ware), Mixed Vegetables, Herbs (Annual), Nuts, Salads

Miles, Gerald, Mr — 01348 831244 — 01348 831244 — G4085 — 74.6 ha

G.O. & G.A Miles, Caerhys Farm, Pembrokeshire, SA62 6DX
ger.miles@il2.com

Licenced for Organic — Pigs, Cereals, Grass & Forage, Potatoes

Plant, Michael, Mr — 01437 720840 — 01437 721350 — G6172 — 13 ha

Lower Treginnis Farm, St Davids, Pembrokeshire, SA62 6RS

Licenced for Organic — Potatoes, Vegetables, Dairy Goats/Milk, Poultry - Eggs, Grass & Forage

Non-Organic — Beef Cattle, Pigs

Ray, M J, Mr — 01239 881265 — R28WW — 2.5 ha

Pencrugiau, Velindre, Crymmych, Pembrokeshire, SA41 3XH
mike@organic.fslife.co.uk

Licenced for Organic — Legumes, Roots, Salads, Potatoes, Vegetables, Greenhouse Crops, Herbs, Plant Raising

Rowlands, Mr D & Mrs G — 01437 720227 — 01437 720227 — G2712 — 53.8 ha

Penarthur Farm, St Davids, Pembrokeshire, SA62 6PG
david.m.rowlands@btinternet.com

Licenced for Organic — Sheep, Potatoes, Cereals, Grass & Forage, Poultry - Eggs

S Rees-Thomas & Mr N Thomas, Mr	01834 871 801	01834 871 801	T17C	57.5 ha
	Freshfield Farm, Manobier Station, Nr Tenby, Pembrokeshire, SA70 9VV			
Licenced for Organic	Grass & Forage, Plant Raising, Sheep, Vegetables			
Non-Organic	Grass & Forage			
Sarra, M R, Mr	01437 762323		G621	32.5 ha
	Upper Hill Moor Farm, Portfieldgate, Haverfordwest, Pembrokeshire, SA62 3LT			
Licenced for Organic	Cereals, Grass & Forage, Potatoes, Vegetables, Poultry - Eggs			
Non-Organic	Beef Calves/Stores			
Steer, John, Mr	01646 698997		G1821	30.5 ha
	Pigscot Farm, Herbrandston, Milford Haven, Pembrokeshire, SA73 3SJ			
Licenced for Organic	Vegetables, Grass & Forage, Greenhouse Crops, Plant Raising, Roots			
Storrow, P	01437 781078	01437 781078	G2431	129.5 ha
	PA & JO STORROW, Rogeston Farm, Haverfordwest, Pembrokeshire, SA62 3LF peter@pstorrow.fsnet.co.uk			
Licenced for Organic	Grass & Forage, Beef Cattle, Sheep, Cereals, Potatoes			
Thurlow, J, Mr	01239 881358		G5716	10.2 ha
	Penygraig Uchaf, St Dogmaels, Cardigan, Pembrokeshire, SA43 3LZ			
Licenced for Organic	Vegetables, Potatoes, Cereals, Grass & Forage			
Van Der Spoel, K, Mr	01348 831352	01348 831352	G2542	86.7 ha
	Castle Villa Partners, Castle Villa Farm, Haverfordwest, Pembrokeshire, SA62 5PX kees@farmersweekly.net			
Licenced for Organic	Beef (Finished Beef), Potatoes (Ware), Grass & Forage, Beef (Store Cattle)			
Non Organic	Grass & Forage			
Conversion	Land			
Williams, DC & Mrs PA, Dr	01437 781234		G4793	29.3 ha
	Shortlands, Haverfordwest, Pembrokeshire, SA62 3NE davidandpam@btconnect.com			
Licenced for Organic	Vegetables, Beef Cattle, Potatoes, Sheep, Cereals, Grass & Forage, Soft Fruit, Beef - Finished, Beef/Store cattle			
Converted Breed Stock	Beef Cattle			
Wolsey, Christopher, Mr	07970 072184	01437 741781	G7141	61.4 ha
	C G Wolsey, Lammas Farm, Haverfordwest, Pembrokeshire, SA62 5DY			
Licenced for Organic	Beef Cattle, Sheep, Cereals, Grass & Forage, Potatoes			
Young, AWJ, Mr	01437 890268	01437 890268	G7191	34.3 ha
	AWJ Young & Son, Upper Bastleford, Milford Haven, Pembrokeshire, SA73 1JY			
Licenced for Organic	Grass & Forage, Cereals, Potatoes, Beef Cattle			

Powys

Benham, Paul	01497 847636		B56WW	2.5 ha
	Primrose Farm, Felindre, Brecon, Powys, LD3 0ST			

Licenced for Organic	Potatoes, Soft Fruit, Herbs, Vegetables, Grass & Forage, Greenhouse Crops, TopFruit - Dessert, Farm Shop/Retail Sales			
Davies, E W, Dr	01654 702400	01654 702782	L09WW	16.2 ha
	Centre for Alternative Technology, Llwyngwern Quarry, Machynlleth, Powys, SY20 9AZ			
Licenced for Organic	Chicken (Eggs), Mixed Vegetables, Greenhouse Crops, Soft Fruit (Berries/Currants), Grass & Forage, Apples (Culinary), Goats (Milk)			
Non-Organic	Poultry - Meat, Pigs			
Gorst, Elizabeth, Mrs	01547 550208	01547 550309	G5456	166 ha
	Dol-Llugan, Bleddfa, Knighton, Powys, LD7 1NY			
Licenced for Organic	Grass & Forage, Sheep, Beef Cattle, Roots, Potatoes			
Hodges, J M, Mr	01874 730541		G2713	30.9 ha
	Cwmffrwd Farm, Pengenffordd, Brecon, Powys, LD3 0ES			
Licenced for Organic	Sheep, Grass & Forage, Roots			
Hogg, G, Mr	01874 636202	01874 636202	G4529	1.5 ha
	Penpont Enterprises, Penpont Estate, Brecon, Powys, LD3 8EU penpont@clara.co.uk			
Licenced for Organic	Soft Fruit (Various), Greenhouse Crops, Apples (Dessert), Mixed Vegetables, Potatoes (Ware), Apples (Cider), Apples (Culinary)			
Moorhouse, Michael, Mr	01938 500128		G2967	5.6 ha
	Cefn Goleu, Pont Robert, Meifod, Powys, SY22 6JN cefngoleuturkeys@btclick.com			
Licenced for Organic	Wool, Turkeys, Top fruit - Dessert & Culinary, Sheep, Chicken - Eggs, Pigs, Chicken - Meat, Grass & Forage, Soft Fruit, Turkey Eggs, Vegetables			
Nixon, Nigel, Mr	01982 551242	01982 551242	G5425	91 ha
	Penmincae Farm, Cwmbach Lechrhyd, Builth Wells, Powys, LD2 3RP			
Licenced for Organic	Grass & Forage, Cereals, Potatoes, Beef /Calves, Beef/Store Cattle, Finished Lamb			
Converted Breed Stock	Sheep, Beef Cattle			
Spencer, N, Mr	01597 824623	01597 824738	G1681	3.2 ha
	Radnor Support Project Ltd, Wellfield House, Llandrindod Wells, Powys, LD1 5HG			
Licenced for Organic	Trees & Shrubs, Soft Fruit, Potatoes, Plant Raising, Vegetables, Greenhouse Crops, Grass & Forage, TopFruit - Dessert			
Non-Organic	Grass & Forage			
White, C J, Mrs	01686 670561	01686 670632	G2363	2.9 ha
	Snowfield, Kerry, Newtown, Powys, SY16 4LP			
Licenced for Organic	Soft Fruit (Berries/Currants), Grass & Forage, Mixed Vegetables, Topfruit - Dessert & Culinary, Plant Raising, Herbs (Perennial), Herbs (Annual)			

West Glamorgan

Lewis, Paula, Mrs	01792 864090	01792 864090	G7383	15.6 ha
	Llwyn Meudwy Isaf Farm, Llangiwg Church Road, Pontardawe, West Glamorgan, SA8 4TS			
Licenced for Organic	Beef (Breeding Stock), Duck (Eggs), Duck (Ducklings), Mixed Vegetables, Greenhouse Crops, Beef (Calves), Beef (Finished Beef), Sheep (Store Lambs), Grass & Forage, Dairy Cattle/Milk, Duck (Table Birds), Chicken (Eggs), Chicken (Pullets), Chicken (Table Birds), Turkeys (Table Birds)			

APPENDIX 6

GROWERS LIST

ORGANIC FARMERS AND GROWERS LTD

Mark Watkin Jones	Mr	M	Watkin Jones		Bryn Bedwog	Rhosygwaliau	Bala	Gwynedd	LL23 7ET
GO & EL Edwards	Mr	G O	Edwards	Tanrallt Farm		Henryd	Conwy	Gwynedd	LL32 8EZ
R & EJ Bowker	Mr	R	Bowker	Rhysnant Farm		Four Crosses	Llanymynech	Powys	SY22 6PS
P Sargent	Mr	P	Sargent	Cilrath Fach			Narberth	Pembrokeshire	SA67 7EY
MC Jones & Co.	Mr	P	Jones	Dollas		Berriew	Welshpool	Powys	SY21 8AQ
IJJ Davies	Mr	IJJ	Davies	Cefnyresgair			Llanwrtyd Wells	Powys	LD5 4TD
DC Roberts	Mr	D	Roberts	Bryn Dowsi		Gyffin	Conwy	Gwynedd	LL32 8YF
G & H Jerman	Mr	G	Jerman	Tynyrwtra		Adfa	Newtown	Powys	SY16 3BT
Mrs E Coomber	Mrs	E	Coomber	Penclawdd Isaf		Rhos Llangeler	Llandysul	Carmarthenshire	SA44 5HF
RE & SM Lewis	Mr	R E	Lewis	Bryn-y-Groes Farm		Glyn Ceiriog	Llangollen	Denbighshire	LL20 7NF
DG & OD Adams	Mr	DG	Adams		The Green	Redstone Road	Narberth	Pembrokeshire	SA67 7ES
JD & EAA Bally	Mr	JD	Bally	Lane Farm		Painscastle	Builth Wells	Powys	LD2 3JS
Wallace Bebb Farms Ltd	Mr	M	Bebb	Bronafon		Llansantffraid	Oswestry	Powys	SY22 6TB
DN Bennett & Son	Mr	NA	Bennett	Upper Hall			Meifod	Powys	SY22 6HR
RJ Best	Mr	RJ	Best	Plas Yn Vivod		Vivod	Llangollen	Denbighshire	LL20 7LS
DP & PM Bevan	Mrs	PM	Bevan	New Building		Maesmynis	Builth Wells	Powys	LD2 3HT
DH, FM & BD Blackwell	Mr	BD	Blackwell	Perth-y-Pia		Llanfapley	Abergavenny	Monmouthshire	NP7 8SW
GJ Burrowes	Mr	GJ	Burrowes	Lane Farm		Criggion	Shrewsbury	Shropshire	SY5 9BG
JO,TL&DJ Cole	Mr	JO,TL &DJ	Cole	Jericho		Martletwy	Narberth	Pembrokeshire	SA67 8AS
Coleg Meirion - Dwyfor	Mr	E	Edwards	Glynllifon	Clynnog Road		Caernarfon	Gwynedd	LL54 5DU
Mrs A Colledge	Mrs	A	Colledge	Gwarmacwydd Farm	Gwarmacwydd	Llanfallteg	Whitland	Carmarthenshire	SA34 0XH
HP & SA Cory	Mr	H	Cory	Maendy Farm		Peterston-Super-Ely		Glamorgan	CF5 6NE
GT Cowcher	Mr	GT	Cowcher	Penrhiw		Capel Dewi	Llandysul	Ceredigion	SA44 4PE
CWJ & DJ David	Mr	W	David	Pentrehowell		Llanddowror	St Clears	Carmarthenshire	SAA 4HN
C & A Davies & Son	Mr	C	Davies	Dwyrhiew Farm		Newmills	Newtown	Powys	SY16 3NW
DW & GH Davies	Mr	D W	Davies	Fferm Tynewydd		Blaenannerch	Aberteifi	Ceredigion	SA43 2AD
KA Davies	Mr	KA	Davies	Maesclettwr		Erwood	Builth Wells	Powys	LD2 3YU
LJ Davies	Mr	LJ	Davies	Coed Ddu Farm		Crynant	Neath	Glamorgan	SA10 8SU
TRW, PW & RL Davies	Mr	P	Davies	Slade		Southern Down	Bridgend	Glamorgan	CF32 0RP
TS & CHT Davis	Mrs	C	Davis	Esgairdraenllwyn		Llaithddu	Llandrindod Wells	Powys	LD1 6YS
KE & LRC Edwards	Mr	L	Edwards	Severndale Farm		Tidenham	Chepstow	Monmouthshire	NP16 7LL
RM Edwards	Mr	RM	Edwards	Ger-y-Coed		Cwmsymlog	Aberystwyth	Ceredigion	SY23 3EZ
HL & EM Evans	Mr	HL	Evans	Lan Farm		Meidrim		Carmarthenshire	SA33 5NY
NT & RS Fromant / Welsh Fruit Stocks	Ms	RS	Fromant	Welsh Fruit Stocks	Llanerchir	Bryngwyn (Powys)	Via Kington	Herefordshire	HR5 3QZ

GIJ, VAL & GL George	Mr	G	George	St Elvis Farm		Solva	Haverfordwest	Pembrokeshire	SA62 6XL
Great Wedlock Farms	Mr	S	Meyrick	Great Wedlock Farm		Gumfreston	Tenby	Pembrokeshire	SA70 8RB
GTP Hammonds & Co	Mr	L	Hammonds	Rhiw Farm	Hundred House		Llandrindod Wells	Powys	LD1 5RY
W Hamnett	Mr	W	Hamnett	Nant Climbers	Red Hall Lane	Penley	Wrexham	Clwyd	LL13 0NA
JC Harris & ML Howe	Mr	J	Harris	Hafod Farm		Cilgerran	Cardigan	Pembrokeshire	SA43 2RG
Hudson Farming	Mr	M	Hudson	The Farm Office		Rhewl	Ruthin	Denbighshire	LL15 2UB
EP Hunt	Mr	E P	Hunt	Tyr Pwll Farm		Hardwick	Abergavenny	Monmouthshire	NP7 9AB
DM, DWH & JM James	Mr	H	James	Trefach Nevern			Newport	Pembrokeshire	SA42 0NQ
JRF James & Sons	Mr	JRF	James	Barretts Hill		Steynton	Milford Haven	Pembrokeshire	SA73 1HH
ME James	Ms	ME	James	Goetre Isaf		Betws Bledrws	Lampeter	Ceredigion	SA48 8NP
PA James	Mr	PA	James	Minwear Farm		Martletwy	Narberth	Pembrokeshire	SA67 8BJ
C Jay	Mr	C	Jay	Slieve Ynys Farm	Garnswllt Road	Pontarddulais	Swansea	Glamorgan	SA4 1QH
DL Jenkins & AH Rees	Mr	A	Jenkins	Trefere Fawr		Penparc	Cardigan	Ceredigion	SA43 1RL
PS & DC Jenkins & Son	Mr	J	Jenkins	Wern-y-Melin		Tregaer	Raglan	Monmouthshire	NP15 2LH
G & M John	Mr	G	John	Parc Gilfach		Llangynog	Carmarthen	Carmarthenshire	SA33 5DH
AL Jones & Son	Mrs	C	Jones	Upper Yardro		Old Radnor	Presteigne	Powys	LD8 2RP
DI & EM Jones	Mr		Jones	Cwm Farm		Carno	Caersws	Powys	SY17 5JY
DK Jones & Co.	Mr & Mrs	K & H	Jones	Tircapel		Crai	Brecon	Powys	LD3 8PU
DA & SJ Jones	Mr	DA	Jones	Dyffryn		Aberhafesp	Newtown	Powys	SY16 3JD
GO & ML Jones	Mr		Jones	Pen Lan Farm			Llangollen	Denbighshire	LL20 7BU
J Gwynfor Jones & Partner	Mr	I W	Jones	Groes Bach		Groes	Dinbych	Denbighshire	LL16 5RS
JR & SL Jones	Mr	SL	Jones	Moreton Farm		Gyfelia	Wrexham	Clwyd	LL13 0YH
PT & CD Jones	Mr	P	Jones	Clyttie Cochion		Llanpumsaint	Carmarthen	Carmarthenshire	SA33 6BT
Emrys Jones	Mr	E	Jones	Lluest Wen		Comins Coch	Machynlleth	Powys	SY20 8LS
Ritec Valley Organics	Mr	J	Joseph	Roberts Wall Farm		Penally	Tenby	Pembrokeshire	SA70 8NF
AJ & H Kehoe	Ms	H	Kehoe	Tyddyn Isaf		Tal y Bont	Bangor	Gwynedd	LL57 3YE
RA Kellett	Mr	R A	Kellett	Pwllhalog		Cwm	Dyserth	Denbighshire	LL18 6EE
KP & SA Lamb	Mr	K P	Lamb	Amalecco		Llangynog	Carmarthen	Carmarthenshire	SA33 5HS
WJ & ED Lawrence	Mr		Lawrence	Blaenclettwr		Talgarreg	Llandysul	Ceredigion	SA44 4XE
DJ & MD Lewis	Mr	J	Lewis	Ffosdwn		Dihewyd	Lampeter	Ceredigion	SA48 7PZ
DT & DMJ Lewis	Mr	A	Lewis	Vronganllwyd		Llanbister	Llandrindod Wells	Powys	LD1 6SS
JR, PEB & RG Lewis	Mr	RG	Lewis	Fferm Tresinwen			Goodwick	Pembrokeshire	SA64 0JL
S Lewis	Mr	S	Lewis	Middle Hook Farm		Robeston Wathen	Narberth	Pembrokeshire	SA67 8EY
R Llewellin	Mr	R	Llewellin	Whitegates Farm		Little Haven	Haverfordwest	Pembrokeshire	SA62 3LA

AJ Lloyd & Son	Mr	RWJ	Lloyd	Pendre Farm		Painscastle	Builth Wells	Powys	LD2 3JL
DE & DAT Lloyd	Mr	D E	Lloyd	Hengoed		Four Roads	Kidwelly	Carmarthenshire	SA17 4SH
LA & SM Lloyd	Mr	A	Lloyd	Severn House Farm		Criggion	Shrewsbury	Shropshire	SY5 9BE
JJSV & MJ Lloyd Williams	Mr	JJSV	Lloyd Williams	Moelgolomen			Talybont	Ceredigion	SY24 5DW
Mr R W Ballard	Mr	R	Ballard	Lower Honeyhook Farm		Portfield Gate	Haverfordwest	Pembrokeshire	SA62 3NR
Mr & Mrs Luxton	Mr	R	Luxton	Lower Pengarth Farm		Painscastle	Builth Wells	Powys	LD2 3JQ
AA Martin	Mr	AA	Martin	Hendy Farm	Bont	Llanvetherine	Abergavenny	Monmouthshire	NP7 4NS
DT & S Miles	Mr	D	Miles	Barnsley Farm		Crowhill	Haverford West	Pembrokeshire	SA62 6HT
H&G Philipps	Mr	G	Williams	Great House Farm	llansteffan	llyswen	Brecon	Powys	LD3 0YS
DGW & CJ Morgan	Mr		Morgan	Dolachddu		Cilycwm	Llandovery	Carmarthenshire	SA20 0TL
G Morgan	Mrs	G	Morgan	Bryngwyn Farm			Llanon	Ceredigion	SY23 5LA
HL Morgan & Son	Mrs	A	Morgan	Race Farm		Panteg	Pontypool	Gwent	NP4 0TP
GJ & MM Morris	Mr	GJ	Morris	Graig Barn Farm	Llangenny Lane	Crickhowell		Powys	NP8 1HB
AT Owen	Mr	AT	Owen	Cloesffynnon			Llanidloes	Powys	SY18 6JU
Mrs Ann Owen	Mrs	A	Owen	Banc		Llwynygroes	Tregaron	Ceredigion	SY25 6QB
VF Parker & Co	Mr	C	Parker	Hem House Farm		Parkside, Rossett	Wrexham	Clwyd	LL12 0BW
TNH & JR Phillips and WAJ & GA Evans	Mr	A	Evans	Pensarn		Brynberian	Crymych	Pembrokeshire	SA41 3TG
DJ & WD Powell	Mr	W	Powell	Middle Genffordd Farm		Talgarth	Brecon	Powys	LD3 0EH
ALL & GM Pryce	Mr		Pryce	Newhouse		Aberhafesp	Newtown	Powys	SY16 3HH
E Pryce Jones & Son	Mr & Mrs	P & S	Jones	Clegyrnant		Llanbrynmair		Powys	SY19 7EA
DA Pugh & Son	Mr	DA	Pugh	Treburvaugh			Knighton	Powys	LD7 1SG
DR & JM Pugh	Mrs	J	Pugh	Crickie Farm		Llangorse	Brecon	Powys	LD3 7TU
EA & MP Rees	Mr	J	Rees	Dugwm Farm		Mochdre	Newtown	Powys	SY16 4JP
G Roberts	Mr	G	Roberts	Dolhendre Isa		Llanuwchllyn	Bala	Gwynedd	LL23 7TD
EA & HF Rogers	Mr	A	Rogers	New Hall Farm		Chirk	Wrexham	Clwyd	LL14 5AD
AT Ruell & Son	Mr	T	Ruell	Tregriggan		Dolau	Llandrindod Wells	Powys	LD1 5TW
Capestone Organic Poultry Ltd	Mr	J	Scale	Woodhaven		Walwyns Castle	Haverfordwest	Pembrokeshire	SA62 3DY
Severn Trent Water Ltd (Wales)	Mr	M	Anwyl	Lake Vyrnwy Estate & Garthmyl	c/o Berrys, 2 Darwin Court	Clayton Way	Oxon Business Park, Shrewsbury	Shropshire	SY3 5AL
C & HM Sneade & Son	Mr	I	Sneade	Trwstllewelyn		Garthmyl	Montgomery	Powys	SY15 6SE
J & A Snow	Mr & Mrs	J & A	Snow	Brynhelyg		Llandinam		Powys	SY17 5AQ
South Shropshire	Mr	Kevin	Nicholls	Brays Tenement		Marton Hill	Welshpool	Powys	SY21 8JY

Meadow

JH & IM Taylor	Mr	J H	Taylor	Stryt Fawr Farm		Llanychan	Ruthin	Denbighshire	LL15 1UF
PWL Thomas	Mr	G	Turner	Penddol Farm		Llanfair Clydogau	Lampeter	Ceredigion	SA48 8LH
GM Thomas	Mr	GM	Thomas	Cwmonnen		Llanuwchllyn	Bala	Gwynedd	LL23 7UG
DJ & AM Vaughan	Mr	DJ	Vaughan	Bryn Cain		Penpergwm	Abergavenny	Monmouthshire	NP7 9AE
DB & CA Walters	Mr	B	Walters	Clynmelyn		Ffynnonddrain	Carmarthen	Carmarthenshire	SA33 6EE
MW Watkins	Mr	MW	Watkins	Ty Du Farm	Llanarth	Raglan	Usk	Gwent	NP15 2LY
R & B Watkins	Mrs	R	Watkins	Ty Du Farm		Llanarth	Raglan, Usk	Gwent	NP15 2LY
SD Watkins	Mr	SD	Watkins	Treloyvan		Llantilio Crossenny	Abergavenny	Monmouthshire	NP7 8UE
Wern Poultry Producers	Mr	JM	Shepherd-Foster	Wern Villa		Rhydcymerau	Llandeilo	Carmarthenshire	SA19 7RP
DN Williams	Mr	DN	Williams	Cwmdylluan		Van	Llanidloes	Powys	SY18 6NR
S & DJ Williams	Mr	J	Williams	Cefn Llech		Pant y Dwr	Rhayader	Powys	LD6 5LR
DV & BE Wilson	Mr	D V	Wilson	West Pool			Pendine	Carmarthenshire	SA33 4PS
J Wright	Mrs	J	Wright	Glanusk Home Farm		Crickhowell		Powys	NP8 1LP
RE Cookson & Son	Mr	E T	Cookson	Dyffryn		Berriew	Welshpool	Powys	SY21 8AE
EM & DE Jones	Mr	D	Jones	Fferm			Llansantffraid	Powys	SY22 6XS
D C Pritchard	Mr	D C	Pritchard	Glan-Mor Isaf		Talybont	Bangor	Gwynedd	LL57 3YH
R & R Owen	Mr	R	Owen	Brodawel		Bettws	Newtown	Powys	SY16 3LF
M/S RJ & A Pugh	Mr	A	Pugh	Ty-Mawr		Penegoes	Machynlleth	Powys	SY20 8UW
T Davies & Sons	Mr	R T O	Davies	Bailey Bog		Bwlch-y-Sarnau	Rhayader	Powys	LD6 5NF
M Wakelin	Mr	M	Wakelin	Cwm Clyd		Llanilar	Aberystwyth	Ceredigion	SY23 4SL
E & G Jones & Sons	Mr	DP	Jones	Maesterran		Penegoes	Machynlleth	Powys	SY20 8UW
AW & M Jones	Mr	G	Jones	Segrwyd Ucha		Peniel		Denbighshire	LL16 4TU
Dr Ruth Watkins	Dr	R	Watkins	Pengraig Coch		Llanddeusant	Llangadog	Carmarthenshire	SA19 9TH
DR Lewis	Mr	DR	Lewis	Cefn Barhedyn		Aberhosan	Machynlleth	Powys	SY20 8SJ
Williams & Ridgway	Mr	R	Ridgway	Clovers Farm		Letterston	Haverfordwest	Pembrokeshire	SA62 5TT
Mervyn Jones	Mr	M	Jones	Glantrannon		Trefeglwys	Caersws	Powys	SY17 5PL
MLM Mainwaring & Partners	Mr	MLM	Mainwaring	Penplas Fawr Farm	Fforestfach		Swansea	West Glamorgan	SA5 7LA
DG, DMJ & RJ Williams	Mr	R	Williams	Tyfos		Llandrillo	Corwen	Denbighshire	LL21 0TA
Mr J & Mrs LS Lydiate	Mr	J	Lydiate	Tynberth	Abbey Cwm Hir		Llandrindod Wells	Powys	LD1 6PU
Miss Eirian Evans	Miss	E	Evans		Dugoed	Llanon	Near Aberystwyth	Ceredigion	SY23 5LW
DL Jones	Mr	DL	Jones	Y Ddol Farm	Llanbadarn Fynydd		Llandrindod Wells	Powys	LD1 6YB
R&M Becker	Dr	MP	Becker	Llwynderw Farmhouse	Old Hall	Llanidloes		Powys	SY18 6PW
DH Jones	Mr	D L	Jones	Upper Esgair		Llanbadarn Fynydd	Llandrindod Wells	Powys	LD1 6YF
EO Jones & Son	Mr	DRO	Jones	Berthlwyd			Talybont	Ceredigion	SY24 5DH

Mr JW Jones & GA Jones	Mr	JW	Jones	Cadwst Mawr		Llandrillo	Corwen	Denbighshire	LL21 0TD
WA Morgans	Mr	WA	Morgans	Llidiarddau		Tylwch	Llanidloes	Powys	SY18 6JW
AJ Beavan & Partners	Mr	A	Beavan	Black Hall	Llanfair Waterdine		Knighton	Powys	LD7 1TU
PR Bufton	Mr	PR	Bufton	Cwmcefn-Y-Gaer		Llanddewi	Llandrindod Wells	Powys	LD1 65N
VR Jones & Sons	Mr	R	Jones	Abergwynant Farm		Penmaenpool	Dolgellau	Gwynedd	LL20 1YF
Trevor Davies	Mr	T	Davies	Lasgarn Farm		Trevethin	Pontypool	Gwent	NP4 8TR
TG & HM Williams & Son	Mr	MR	Williams	Slwch Farm			Brecon	Powys	LD3 9SP
RJK Evans	Mr	RJK	Evans	Alltygrug		Llangain	Carmarthen	Carmarthenshire	SA33 5AY
S & C Bufton	Mr	JTC	Bufton	Trevol		Llanddewi	Llandrindod Wells	Powys	LD1 6SW
SR & KP Turner	Ms	K	Turner	Tyriet		Cilgwyn	Newport	Pembrokeshire	SA42 0QW
CS & NE Smith	Mr	S	Smith	Penygraig Farm		Llanwenarth Citra	Abergavenny	Monmouthshire	NP7 7LA
BR Powell	Mr	BR	Powell	Hall Farm		Llangenny	Crickhowell	Powys	NP8 1EU
DT & ASL Lewis - Ddole	Mr	A	Lewis	Vroganllwyd		Llanbister	Llandrindod Wells	Powys	LD1 6SS
Rhos-Y-Gilwen Farm	Mr	AD	Williams		9 Gelliwen	Llechryd	Nr Cardigan	Ceredigion	SA43 2PQ
JTP & EP Davies	Ms	A	Davies	Red House		Tregynon	Newtown	Powys	SY16 3ER
Mr JH Jones	Mr	JH	Jones	Fad Filltir		Trawsfynydd		Gwynedd	LL41 4TP
Roger Capps	Mr	R	Capps	The Ciliau		Llandeillo Graban	Builth Wells	Powys	LD2 3TZ
RB, R & SE Owen	Mr	RB	Owen	Nan-Y-Celyn		Clocaenog	Rhuthin	Denbighshire	LL15 2AT
RT & MI Fear & Sons	Mr	R	Fear	Tynffynnon Farm	Cilcennin		Lampeter	Ceredigion	SA48 8DH
HD Pugh & M Wynne-Pugh	Mr	HD	Pugh	Tanycoed Ucha		Bryncrug	Tywyn	Gwynedd	LL36 9UP
RJ & BA Moseley	Mr	R	Moseley	Penuwch	Salem Road	St. Clears		Carmarthenshire	SA33 4DH
Sion Ifans	Mr	S	Ifans	Dolau		Llanbrynmair		Powys	SY19 7DL
Clawdd y Mynach Ltd	Mr	P	Davies	Slade		Southern Down	Bridgend	Glamorgan	CF32 0RP
P Bowen	Mr	P	Bowen	Penlanole	Llanwrthwl	Nr Llandrindod	Wells	Powys	LD1 6NN
E D Jones	Mr	E D	Jones	Pengraig		Ystrad Meurig		Ceredigion	SY25 6AB
I & LL Rees	Mr	E	Rees	Esgairmaen	Y Fan		Llanidloes	Powys	SY18 6NT
HP & SA Cory	Mr	H	Cory	Maendy Farm		Peterston-Super-Ely		Glamorgan	CF5 6NE
T Mellor & Son	Mr	T	Mellor	Hunmanby Grange		Wold Newton	Driffield	East Yorkshire	YO25 3HS

APPENDIX 7

REGISTERED MEMBERS WHOLESOME FOOD ASSOCIATION LTD

Appendix 7 Registered members Wholesome Food Association Ltd

Lennox	Jane	Oaktree Cottage	Conjurors Pitch,		KNIGHTON	Powys	LD7 1UP
Horne	Carol	TRW Cottage Garden	Tan Rath Wen		BEAUMARIS	Anglesey	LL58 8TR
Burridge	Dave	40 Church St	Llanfaes		BRECON	Powys	LD3 8BY
Toomey	Theresa	Pwllyn Brwnt Farm	Libanus		BRECON	Powys	LD3 0ST
Wickham	Lesley	Cwmchwefru Farm	Llanafan Fawr		BUILTH WELLS	Powys	LD2 3PW
Harris	Judy	Trigonos	Plas Baladeulyn	Nantlle	CAERNAFON	Gwynedd	LL54 6BW
Smith	Bob	Oerffrwd Cottage	Clatter		CAERSWS	Powys	SY17 5NP
Endres	Ian	Cae'r Felin Fresh Produce		Cae'r Felin	GROES	Denbighshire	LL16 5SB
Allerton	Les	Dan-yr-Awyr,	Longwood,	Llanfair-Clydogau	LAMPETER	Ceredigion	SA48 8NE
Swan	Gill	Beiliglas	Myddfai		LLANDOVERY	Carmarthen	SA20 0QB
Williams	Dafydd Emyr	Cnydau'r Castell	Castell	Penmynydd	LLANFAIRPWLL	Anglesey	LL63 6PG
Peace	Jeff & Jean	Glynfach Farm	Pontyates		LLANFLI	Carmarthen	SA15 5TG
Edwards	Richard & Joy	Humungus Fungus	Y Ffatri Manarch	Llanddeusant,	LLANGADOG	Carmarthen	SA19 9HD
Joy	Beryl & Bob	Cwm Dylan			LLANGAMMARCH WELLS	Powys	LD4 4BS
Gaunt	Mary	Penhwnllys Plas			LLANGOED	Anglesey	LL58 8PW
Storr	Sandra	Savages	11 Mountain Rd		LLANLLECHYD	Gwynedd	LL57 3HS
Stacey	Helen	Organics Around Wales	Warren Cottage		LLANSAWEL	Carmarthen	SA19 7PQ
Blackmore	Pat	Can y Lloer	Ffarmers		LLANWRDA	Dyfed	SA19 8JH
Thomas	Mandy		Bryndyfan Stud	Llansadwrn	LLANWRDA	Carmarthen	SA19 8NL
Leverett	Paul	Fron Dolfor Farm	Llanllwchaiarn,		NEWTOWN	Powys	SY16 3BH
Madge	Pauline	Castell-Isaf Wholesome Vegetables	Adfa	Castell-Isaf	NEWTOWN	Powys	SY16 3DH
Northridge	Richard	Cwm Harry Land Trust,	Lower Cwm Harry	Tregynon	NEWTOWN	Powys	SY16 3ES
Owen	Ralph	Ralph's Cider	Old Badland	New Radnor	PRESTEIGNE	Powys	LD8 2TG
Harris	Carol	Pentre Pigs	Pentre House	Leighton	WELSHPOOL	Powys	SY21 8HL
Cook	Robin	Treforest Community	School of Technology/Div. Environment & Geography	University of Glamorgan		Glamorgan	CF37 1DL
Davies	Suzanne	Co-ordinator, Powys Food Links	Antur Gwy	Park Rd	BUILTH WELLS	Powys	LD2 3BA
Morgan	Kate	Food & Craft Officer	Pembrokeshire County Council		HAVERFORDWEST	Pembs	
Moller	Vicky	Fachongle Isaf			NEWPORT	Pembs	SA42 0QR
Keane	Rose	Saffron	48 High Street		LLANBERIS	Gwynedd	LL55 4EU
Raymond-Barker	Kathleen	Bron Hafod	Cwmwysg	Trecastle	BRECON	Powys	LD3 8YF
de Grandis	Annette	Springfield	Crickadarn		BUILTH WELLS	Powys	LD2 3AQ
McPhee	Beth	41 Trem-y-Noddfa		Carno	CAERSWS	Powys	SY17 5LJ
Welburn	Muriel	Hendre Cerniog	Carno		CAERSWS	Powys	SY17 5JP
Plummer	Iain	Ty Nant		Felindre	KNIGHTON	Powys	LD7 1YN
Porter	Helen	Bwlchyffridd			NEWTOWN	Powys	SY16 3JW
Cook	Robin	125 Rhys St	Trealan	Tonypandy	RHONDDA	Mid Glamorgan	CF40 2QQ
Webber	Dave	Mentro Lluest			ABERYSTWYTH	Ceredigion	SY23 3AU
Lampard	Jenny	Ocean Cottage	Borth		ABERYSTWYTH	Ceredigion	SY24 5JG

Derbyshire	Roger	Caecrwn Farm House	Battle		BRECON	Powys	LD3 9RW
Jones	Tricia	Brecon Beacons National Park	7 Glamorgan St		BRECON	Powys	LD3 7DP
Williams	Janet	Pilgrims	Brecon Cathedral Close		BRECON	Powys	LD39DP
Myhill	Clive	Tyngoed	Disserth		BUILTH WELLS	Powys	LD2 3TN
Lee	Andrea	Hafod Elwy Hall			BYLCHAU	Denbighshire	LL16 5SP
Beckett	Robert	Tangelynen	Waunfawr		CAERNARVON	Gwynedd	LL54 7AX
Fitzpatrick	Pamela	29 Maelpg Pl	Mynachedy		CARDIFF	W Glam	CF14 3ED
Wintle	Mrs Fran	Larkhill,			Cwmduad	Carmarthen	SA33 6AT
Clements	Jayne & Alan	ClynGwyn Farm	nr Ystradfellte,		GLYNNEATH	Powys	SA11 5US
Richards	D.O.	Cefnyfgsgwydd Farm	Bryn Gwran		HOLYHEAD	Anglesey	LL65 3SW
Stirrup	David and Kirsty	Brookfields	Four Roads		KIDWELLY	Carns	SA17 4SE
Benham	Dr Paul	Primrose Organic Farm Centre		Felindre	KNIGHTON	Powys	LD7 0ST
Brookshaw	Hazel	Royal Oak	Cellan Lampeter		LAMPETER	Ceredigion	SA48 GFJ
Jenkins	Clare	Plasnewydd,	Manor Deilo,		LLANDEILO	Carmarthen	SA19 7BE
Sheppard	Ann	PantyBlodau	Bryndu Rd.		LLANDILOES	Powys	SY18 6TH
Smith	Gabi	1 Pwllan Cottages			LLANDINAM	Powys	SY17 5AT
Murphy	Raymond	Green Grove	Penrhiwllan		LLANDYSUL	Ceredigion	SA44 5NG
Startin	Louisa	Maes-y-delyn	Llangnannog,		LLANDYSUL	Ceredigion	SA44 6AL
Sinagola	Janet	Butterfly Farm	Bachie Road		LLANFYLLIN	Powys	SY22 5LA
Beeson	Jennifer	Glynengyll	Brothdir		LLANSYLLIN	Powys	
Scott	Janice	Lloyn Du,	Cemmaes,		MACHYNLLETH	Powys	SY20 9PY
Styles	Mikka	Dewi Sant Housing Association	Harvey Crescent	Aberavon	PORT TALBOT		SA12 6DE
Saint	Mrs Carol	Brynglas,	Clawddnewydd		RUTHIN	Denbighshire	LL15 2NG
Fisher	Kevin	Eithinduon	Llangynin		St Clears		SA33 4LB
Jones	David & Rosemary	Trebersed Farm			ST PETERS	Carmarthen	SA
James	Francesca	Stembridge,	Reynoldston,		SWANSEA		SA3 1BT
Marlow	David	15 Eynon Street	Gorseinon		SWANSEA		SA4 4DU
Richardson	Sandy	2 Broadway Court	Vivian Road,	Sketty,	SWANSEA		SA2 0NA
Denton	Linda	Y Felin Penpompren			TAL Y BONT	Ceredigion	SY24 5HH
Myers	John	Waungron	Cefnypant		WHITLAND	Dyfed	SA34

APPENDIX 8

INTERVIEW LIST AND MILEAGE CHART

Appendix 8 Interview list and mileage chart

1 Dave Burridge. Ffwdgrech Road. Llanfaes. Brecon. Tel (01874) 610488

2 Richard Northridge. Cwm Harri Trust. Lower Cwm Harri. Tregynon. Newtown. Powys SY16 3ES Tel (01686) 6502431 or Mob 07752243431.

3 Bill and Pauline Madge. Castell Isaf.Adfa. Newtown SY16 3DH Tel (01686) 650724

4 Kevin and Davina Hogg. Penpont House. Penpont. Brecon LD3 8EU Tel (01874) 636202

5 Jones. Allotment at Tin Plate Works.125 Morien Crescent. Rhydfelin.

6 Speare. Allotment at Tin Plate Works. Flat 1 Gellihiron Close. Treforest.

7 Reeks. Allotment at Tin Plate Works. 2 Raymond Terrace. Rhydfellin.

8 Chandler Allotment at Tin Plate Works 47 West Street. Trallwyn

9 Chris Downward. Pant Y Turnor. Llanddeusant. Llangadog. Carms. SA19 9TN

10 Mr H.Cory. Maendy Farm Peterson-Super-Ely CF5 6NE Tel (01446) 760264.

11 Bill Lee Croes Heol Llanmars Nr Llantwit Major. Vo f G. Tel (01446) 750072

12 Andy Grenier. Llugwy Farm. Llanbister Road. Llandindrod Wells. LD 5UT.Tel (01547) 550641.

13 Rodney Brown. River View . Llanbister Road. Llandindrod Wells . LD1 6FR Tel (01547) 550231.

14 Mr D. Bennett. Upper Hall. Meiford. Powys. SY22 6HR. Tel (01938) 500252.

15 Janet Jenkins. Pont Farm. Bettws. Newtown. SY16 3BL Tel (01686) 626447.

16 Helen Porter. Penllan. Bwlch-y-Ffridd. Newtown. SY16 3JW. Tel (01686) 650326.

17 Richard Becker. Llwynderw Old Hall. Llanidloes. Tel (01686) 411343.

18 Dave Jones. Offa Farm. Montgomery. (By The Bluebell Pub) Tel (01686) 668485.

19 John Walsh. Upper Aberarth. Abertaeron. Ceredigeon. SA46 0LA. Tel (01545) 571340.

20 Joseph Roberts. Wall Farm. Penally. Tenby. SA70 8NF. Tel (01834) 843390.

21 Martin Griffith. Hook Farm. Amblescon. Haverford West. Pembs.

22 Gareth Palmer. The Nurseries. Houghton Milford Haven. SA73 1NN Tel (01646) 6016470

23 Tim Young and LynWhitmore. Spring Meadow Farm. Caerfarchall. Solva SA62 6G Tel (01437) 721800

24 Andrew Malin. Penpant Farm Solva. Tel (01437) 721369.

25 Alan and Jayne Clements. Clyngwyn Orga. Ystradfellte Road. Pontneddfechan. Powys SA11 5US. Tel (01639) 722930

26 Alec McSkimming. 62 Conway Road. Cardiff CF11 9NW. Tel:029 20 874393 or Mob 07712936599.

27 Beryl and Bob Joy. Cwm Dylan. Llangammarch Wells. (01591) 620295.

28 Shan Fromant. Welsh Fruit Stocks. Llanerchir. Bryngwyn. Powys HR5 3QZ. Tel (01497) 851209

29 Mr GeraldGeorge. Upper Pentwyn Farm . The Flat Abergavenny. Mons. (01873)880848 Mob 07970322850.

30 Mrs J Bevan. Great House Farm. Penpergwm Abergavenny. Mons NP7 9UY (01873)840247.

31 Mr R. Boyle. Carob Growers Llangunville Llanrothal. Mons NP25 5QL. (01600)714529.

32 Mrs Ann Evans (Mr Seggar) Blaen Camel Farm. Cilcennin, Lampeter. Ceredigion. SA48 80B. Phone (01570) 470529.(20 B3)

33 Nick Rebbeck. Bwlchwernen Fawr. Llangybi. Lampeter. Ceredigion. SA48 8PS. (01570) 493244. (Partnership Patrick Holden SA)

34 Elizabeth Findlay. Nant Clyd. Rhos Y Garth. Aberystwyth. Ceredigion SY23 4SG. (01974) 241543.Mob 07855731611

35 Mr Ian Hearn. Tren-Y-Gorwell. The Old Barn. Brongest. Ceredigion. (07811) 975869.

36 Mentro Lluest. (Charity) Llanbadarn Fawr. Aberystwyth. Ceredigion SY23 3AU. See Leigh Munton through Helen. (0001970) 612114.

37 Mrs J. Robertson. Tyddyn Adda. Llandaniel. Gaerwen. AngleseyLL60 6HB. (01248) 421661 (01248) 385577.

38 Andrew Hooton. Gwydryn Hoir. Brynsiencyn. Anglesey. LL61 6 HQ. Mob 07747697946 (01248)430344.

39 Roger and Helen Foreman. Ysgubor. Ffordd Cerrig Mawr. Caergeiliog. Holyhead. Anglesey. (01407) 742293.

40 Mike and Gillian Parker. Plas Llanfair. Ynys Mon. Anglesey. LL74 8NU

(01248)852316.

Interview Dates

Sample Numbers	Interview Date
1	05-11-02
2, 3 and 4	11-12-02
5 and 6	04-04-03
7 and 8	07-04-04
9	22-05-03
10 and 11	06-06-03
12, 13, 14, 15 and 16	14-11-03
17, 18 and 19	17-11-03
20, 21, 22, 23 and 24	28-11-03
25	13-06-03
26	29-12-03
27	12-06-03
28, 29, 30 and 31	16-01-04
32, 33, 34, 35 and 36	23-01-04
37. 38, 39 and 40	30-01-04

Time and Mileage

Hours for travel and interviews = 87.4 Total Car Mileage = 1937.

(NB Samples 5, 6, 7 and 8 in walking distance from University of Glamorgan)

APPENDIX 9

PUBLICATIONS

Publication 1

Littlewood, J. R., Cook, R. I. and Smallwood, I. 2002. *Community based sustainable and organic food crop production, in the UK, a solution for the 21st century.* Presented at the 3rd International Sustainable Building Conference, 23^{rd}-25^{th} September. Oslo Norway.

Publication 2

Turner, D. Cook, R. and Littlewood, J. 2006. Dynamic Benchmarking: A local project on national benchmarks. *New Era in Education. Vol 86, Number3. World Education Fellowship. New York. United States of America.*

Appendix 9 Publications

Community based sustainable and organic food crop production, in the UK, a solution for the 21st century

J.R. Littlewood, BSc (Hons), PhD [1]
R.M Cook BA (Hons), MA [2]
I. Smallwood, BSc (Hons), PGCeD [3]

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ABSTRACT

This paper illustrates the growing demand for organic food-crops in Europe, particularly in the UK, and the issues, which prevent the introduction of large-scale organic food-crop production. The production of food-crops following sustainable principles and organic methodologies, from a new sustainable community is discussed as one solution to the growing need for organic food-crops. The problems preventing the expansion of existing and new non-organic food crop production farms are evaluated, including soil erosion, pollution caused by the production and transportation of agro-chemicals, employment, and water pollution. The production of food-crops following sustainable principles and organic methodologies, as part of an existing community is introduced as one solution to the growing need for organic food crops in the UK, and Europe. This latter solution is part of current research project at the University of Glamorgan. Development professionals, and academics who are involved in the expansion, or creation of existing communities will find this paper useful, in evaluating how land can,

and should be set aside for the production of food-crops, following sustainable principles, and organic methodologies.

1. INTRODUCTION

Between 2000 and 2001 the sale of organic produce in Europe has increased by 50% with Britain having the fastest growing organic market within Europe for 2001, accounting for one per cent of the total value of food and drink consumed in the UK (Coghlan et al 2002, Soil Association 2001). However, of major concern is that only 25% of organic produce bought in the UK is grown within the country itself (Coghlan et al 2002). Alone, the pollution caused by transporting 75% of Britain's organic produce from global destinations to Britain, out weighs any environmental advantages of choosing organic produce. For example, 2.5% of Britain's total carbon dioxide emissions (CO2) is attributable to importing food and drink (Pretty 2002).

Perhaps, an immediate solution would be to adopt large-scale production of organic food-crops, in the UK and Europe. Logistically this would prove impractical as land rotation which alternate soil-building crops one year, such as pasture grasses, with food crops the next would be a prerequisite (Coghlan et al 2002). To meet current food crop production levels by non-organic farming methods would require twice the area of land used by non-organic methods, with a catastrophic loss of natural habitats (Coghlan et al 2002). Equally there would be significant problems of environmental pollution, such as those caused by transporting food-crops to consumers, and the potential excess nitrogen from organic manure to pollute water courses (Coghlan et al 2002).

One proposed solution to meet Britain and Europe's needs for organic produce, and at the same time promote the use of sustainable organic principles and methodologies would be to promote local community-level based food-crop production. Indeed, there are many advantages of community food-crop production, including reduction of waste through recycling and composting, a reduction in traffic with its associated pollution, preservation of soils, and efficient use of irrigated water, and the provision of employment. All these latter advantages are significantly impacted upon using convention agro-chemical production (Smit 2002). One example of the viability of a local-level community, which is self-sufficient on locally produced organic food-crops, is the Bioregional development, at Beddington Zero Energy Development (BedZed), in south London, UK (Bioregional 2002). BedZed, consists of a sustainable community of 82 energy efficient flats and houses, which have used reclaimed materials or low embodied energy material in their construction (Bioregional 2002). The philosophy of BedZed is to reduce the ecological footprint of community living in the 21st century, which includes reducing CO_2 emissions from housing, using locally produced organic food-crops, adopting green transport, and the recycling all waste (Bioregional 2002). In addition, the BedZed project incorporates 2500 m^2 of workspace, to reduce the need for travel to places of employment (Bioregional 2002).

However, whilst the above provides a blueprint for sustainability, organic food-crops still represent a small proportion of food-crop production in the UK and Europe (Pretty 2002). There is a need to define some of the key issues relating to the environmental impact of continuing and expanding the existing large-scale non-organic food-crop production in the UK, and Europe if the argument for sustainability is to be understood.

2. KEY ISSUES RELATING TO NON-ORGANIC PRODUCTION OF FOOD-CROPS IN THE UK

Non-organic crop production is associated with many significant environmentally damaging problems, which are often be hidden to both the producer and the consumer of its products. The main problems of non-organic methodology are, soil erosion, and damage to the ecosystem through the manufacture and distribution of agro-chemicals, and the transport of food-crops to consumers (Coghlan et al 2002).

2.1 Soil erosion

The total land area of the UK (excluding Northern Ireland) is 229,334.00 square kilometres (km^2), of which 172,000.05 km^2 is in agricultural use (National Statistics 2001). In 2000, the UK Register of Organic Food Standards, (UKROFS), stated that 329,058.00 Hectares (Hs) of farmed land, was designated organic agriculture land, with a further 143,457.00 Hs of farmed land under conversion to organic agriculture land (Lamkin et al 2001). Thus, in 2000, the total farmed organic agriculture land, was 472,510.00 Hs, or 4,725 km^2 (Lamkin et al 2001]. Similarly, the Soil Association's Organic Food and Farming Report for 2001, estimates that the area of fully organic agriculture land in the UK, for 2001, had grown to 552,500 Hs, or 5,525 km^2 (Soil Association 2001). Therefore, it can be stated that organically managed agriculture land in the UK accounts for 3.2% of the total agricultural land (Soil Association 2001).

Significantly, up to 97%, or approximately, 167,275 km^2 (16,727,500 Hs) of land, is under intensive, or semi-intensive non-organic agricultural use in the UK, which is subjected to the application of synthetic pesticides, herbicides and fertilizers (agro-chemicals). Principally, the application of these chemicals is to promote the rapid growth and increased yields for crops, typically grown within mono-culture systems. The total tonnage of active pesticide ingredient (which includes herbicides, fungicides, insecticides, seed treatment, molluscicides, growth regulators and others) sold to all agricultural sectors in the UK, in 2000 was recorded as 23,650.00 tonnes (Crop Protection Association 2001). Of this tonnage 8,231.20 tonnes was used directly on agricultural land (Crop Protection Association 2001). This equates to an average application of 9.17 tonnes of active pesticide ingredient, per Hectare (H), over the 16,727,50 H of agricultural land designated as being in general agricultural use, within the UK. In addition, in 2000, the application of chemical fertilizers per H, totalled 8.60 tonnes [British Survey of Fertilizer Practice 2000].

It is known that the application of agro-chemicals is a primary cause of soil erosion with a resultant breakdown of soil humus and loss of soil fertility (Selincourt 1997). In Southern England, annual soil erosion losses of between two and 40.00 tonnes per H, have been measured (Selincourt 1997). A measurable loss of crop production is associated with soil erosion, for example, Douthwaite (1996) states that a loss of 12.00 tonnes of soil humus per year reduces crop yield by 8%. This is particularly disconcerting as it takes from 100 to 2,500 years to create 25 mm of fertile soil, and human interference, mainly through the application agro-chemical can destroy 25 mm of fertile soil in less than a decade (Rivers 1988). It is estimated, that on a world-wide basis, the application of agro-chemicals is eroding fertile topsoil at the rate of 25 billion tonnes annually; equivalent to seven percent of the world's soil every decade (Rivers 1988). In the U.S.A, it was predicted by Rivers (1988) that by 2038 the grain harvest would drop by between 50 to 75 million tonnes through the loss of fertile topsoil, over a third of the agriculture land, used for crops production.

2.2 Pollution from the production of agro-chemicals

Unlike, natural organic pest control methods e.g. partner allelopathy, or companion planting and natural organic fertilizers (manure from horses, cattle, and or chickens, fed on non-chemical based products) the production of synthetic pesticides and fertilizers consumes energy. As with all other industries, the use of energy (unless from renewable sources) results in emissions of the five known greenhouse gases, including carbon dioxide (CO_2), and thereby their production directly contributes to global climate change. The majority of synthetic pesticides are manufactured from intermediates derived from ethylene, propylene, or methane (Helsel 1987), which are transformed into the final products by a series of energy demanding chemical reactions involving heating, distilling, filtering and drying (Helsel 1987). In addition to greenhouse gas emissions caused by the manufacture agro-chemicals, their transport from the place of manufacture through the point of sale, to their application on the land are also hidden contributions to the overall greenhouse gas emissions, notably CO_2.

2.3 The hidden cost of pollution from the transport of agro-chemicals

After manufacture, agro-chemicals are packed into suitable containers, and transported to distributors, and ultimately to users for application to crops (Isherwood. 2000). In the UK, 80% of all fertilizers are typically delivered in 500kg bulk containers, with the rest delivered in 50kg bags (Isherwood. 2000). All fertilizers traded in the UK are transported by road (Isherwood. 2000) with 'distributor's vehicles, each travelling between 30 to 40 thousand miles a year, to reduce the need for on-farm storage as a result of stringent health and safety requirements. Typically, two drivers work from each depot, delivering to approximately 200 distributor member stores across Britain (British Agro-chemicals Association 2000). Logistically, this equates to between 12 and 16 million miles of road-based transport annually, contributing significantly to vehicle pollution, which according to Simms (2000), accounts for 80 % of CO_2 from transport, annually, in the UK.

2.4 Employment

In 2000, in the UK, only 7059 people were employed by pesticide manufacturing member companies of the Crop Protection Association (Crop Protection Association 2001). This figure includes 1633 people employed within distributor companies (Crop Protection Association 2001). It can be argued that the loss of employment from the demise of the UK pesticide manufacturing, and distribution, would be negligible and perhaps even advantageous; initially to the health of the redundant workers, and ultimately to the environment. Lampkin (2001) points out that historically, organic farm survey data indicates that overall labour requirements are typically 10-30% higher on organic farms, in comparison to non-organic farms. The agricultural labour force, for the UK, in all farming operations during 1999 was 593,000 (National Statistics 2001) and is in continuous decline. Potentially, it is possible that the change to organic agriculture could provide, between 59,000 and 177,000 extra employment opportunities, more than compensating for the loss of jobs in pesticide manufacturing and distribution, while also addressing in part, the socio-eco-political issue of reversing rural de-population.

2.5 Water pollution from the production and application of agro-chemicals

The residue from the application of chemical fertilizers and pesticides to land is leached into streams, lakes, rivers and aquifers to the detriment of diverse ecosystems, affecting human and animal health (Brenman 1999). Ecosystem damage is mainly caused by herbicidal chemicals and nitrogen from fertilizers, both of which are harmful to aquatic life, as well as being implicated in contributing to cancer in humans (Coghlan et al 2002). Economically, cleaning pesticides from drinking water costs £120 million annually in the UK, and the removal of nitrate £16 million. Whilst dealing with the problems of leached phosphate from fertilizers mixed with soil incurs a £55 million clear up cost. Overall, it was calculated in 1996 that a total of £2,343 million is spent annually, clearing up pollution from agro-chemicals from British watercourses (Pretty et al 2000).

Chemical companies introduce hundreds of new synthetic chemicals on to the market annually; much quicker than toxicologists and regulatory bodies are able to develop new methods, in which to detect them (Bengtsson, cited in Colborn et al 1996). In addition, Bengtsson (Colborn et al 1996), the head of the Swedish Environmental Protection Board's Laboratory for Aquatic Toxicology reported, in 1994, that toxicologists were falling behind in their ability to analyse and identify the contamination they encountered in the environment.

It is clear from the above discussion, that the current system in the UK, and other developing countries within Europe, of intensive non-organic food production, processing, transportation and distribution, is clearly unsustainable, and potentially hazardous to the health of the population at large, and the economic future of the countries that practice these methods. There is an urgent need to redress the problems faced by current practices with a locally-based organic method of food production, processing and distribution in order to achieve improvements in both environmental and personal health and thereby ensuring a sustainable industry that is socially, economically and environmentally responsible. The BedZed scheme discussed above, is a good example of these principles in which locally produced organic food-crops are produced within a sustainable community. However, there are a limited number of existing and planned sustainable communities in the UK, and therefore possibly, the best option to promote the use of locally produced food-crops would be from within existing communities, on a localised level.

3. SUSTAINABLE AND ORGANIC FOOD-CROP PRODUCTION WITHIN EXISTING COMMUNITIES

A current research programme at the University of Glamorgan is investigating the methodologies necessary to establish a community based sustainable and organic agricultural strategy for food-crop production. The primary aim of the research programme, is to test the validity of the theory of localisation, sustainable principles and organic methodologies, within Wales, by determining how members of an existing community can work as volunteers together, and produce organic food-crops on small plots of land, within walking distance of their homes. The research includes interviewing and collating data from an existing group of 10 small-scale, commercial food-crop producers located in South Wales, that follows sustainable principles and organic methodologies, selling their produce through a co-operative. Each of the commercial producers cultivate plots of land up to 0.5 Hs, and although they grow by organic methods due to the small-scale nature of their plots, they are at present unable to register as organic growers under the organic aid scheme (Soil Association 2002). Similar working methods, crops usage, formative structure and subsequent development, labour input, productivity and produce distribution methods will be tested on the community based project, on a small plot of land of 0.15 Hs, that has been provided by the local town council. In addition, the research project will analyse the social issues involved in establishing a community based organic food-crop project. Such issues include the transfer of intrinsic knowledge that is held by the mature members of an existing community to its younger members, thereby ensuring a long-term viability for the programme.

4. CONCLUSIONS

This paper has illustrated the growing demand for organic food-crops in Europe, particularly in the UK, and the issues, which prevent the introduction of large-scale organic food-crop production. The production of food-crops following sustainable principles and organic methodologies, as part of the BedZed sustainable community, in south London, is discussed as one solution to the growing need for organic food-crops. The problem of starting the large-scale production of organic food-crops is seen to be unsustainable, as the demand for land usage is unsustainable, and the associated problems of pollution are prohibitive. Likewise, the problems preventing the expansion of existing and new non-organic food crop production farms are evaluated, which include soil erosion, pollution caused by the production and transportation of agro-chemicals, employment, and water pollution. The production of food-crops following sustainable principles and organic methodologies, as part of an existing community is introduced as one solution to the growing need for organic food crops in the UK, and Europe. This latter methodology is a major component of a research project currently being undertaken by one of the author's, at the University of Glamorgan. Development professionals, and academics who are involved in the expansion, or creation of existing communities will find this paper useful, in evaluating how land within local communities can, and should be set aside for the production of food-crops, following sustainable principles, and organic methodologies.

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Dynamic Benchmarking: A local project on national benchmarks

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Abstract

In order to support the development of vegetable food crop production within schools, as part of the curriculum and as an intervention to improve the nutrition of young people, the authors set out to develop benchmarks which would help teachers to calculate how much land would be necessary in order to make an effective intervention. They also aimed to develop a method for evaluating methods of cultivation and spreading best practice from one school to another.

The authors describe a study of small scale producers of vegetable food crops in Wales. After considering different approaches to the analysis of the data collected, and to its use for benchmarking, the authors concluded that traditional multivariate analysis was not appropriate, and that data envelope analysis (DEA) was a more effective approach.

Faced with the difficulty of producing summary results in a form that could be used by those wishing to benchmark their own practice, i.e. producers of vegetable food crops, the authors concluded that any such analysis would be partial, and would involve losing many of the advantages that DEA brought to the analysis in the first place. Instead, they recommend a benchmarking process described as 'dynamic benchmarking' in which the data of any vegetable producer wishing to benchmark their practice is incorporated into the database, the DEA analysis run in full, and the results interrogated to identify possible areas for improvement.

The authors conclude that the outcome of their study is not specific benchmarks but a process which allows for the development of better practice at the same time as the benchmarking activity leads to continual improvement of the original database.

Introduction

When teachers wish to incorporate lessons from life into the curriculum, they frequently need to evaluate methods to decide what will be practicable within a school setting. In order to produce classroom experiences which are viable and valuable, teachers will frequently need to benchmark processes, and make decisions about the efficiency of the methods employed. Such demands may not only relate to curriculum methods, but may extend to a wide range of processes that are addressed in the course of education.

In recent months a good deal of attention has been focused upon methods that can be employed to improve the nutrition of children, at the same time as developing an educational approach which incorporates nutritional understanding in the curriculum. In the present study the authors look at ways of benchmarking vegetable food crop production, as part of a process to introduce the growing of food crops, and their use, as part of the curriculum of schools in south Wales. Similar approaches to benchmarking may be valuable in other areas of the curriculum, and the present example is put forward as an example of a useful intellectual tool that teachers can use to ensure that the classroom experiences that they provide incorporate best practice.

Benchmarking is an essentially static process. A 'benchmark', originally, was a surveyor's mark cut into the stone beside a road, as a reference point from which heights above sea level could be judged.(Chudley and Green, 2004) The intention of such a system is both static, and one dimensional. The criterion against which judgements are to be made, in the first instance altitude, and the fixed framework of measurement, carried over into the practice of benchmarking.

Those overtones of the term benchmarking, of being a fixed framework of judgement along a single dimension, carried over into the business practice of benchmarking. The idea that one can assess industrial, commercial or professional practice by comparing the sample unit with 'the best of the best' implies that the gold standard of performance in any sphere can be unambiguously identified, and that performance can be measured and reported in secure ways. These assumptions underpin the whole notion that 'best practice' can be identified, indeed underpin the idea that there can be any such thing as 'best practice'.

This paper reports upon a project in benchmarking which started from such a simple set of assumptions. Collection and analysis of the data demonstrated that the area under review was highly complex, and that it was not going to be possible to establish such gold standards of performance. This led to the adoption of a methodological approach that addressed a different range of questions: is it possible to benchmark effectively in a field of endeavour where there is a diverse range of purposes and practice, and where the identification of fixed benchmarks is impossible? The authors of this paper believe that the outcome of this study has implications for the future of benchmarking, and in particular indicates some important opportunities for using the methods developed for benchmarking in a field where there are many dimensions of success, where the current data on performance is poor and where practice may be continually improved.

After a number of false starts with the analysis of data, the authors concluded that Data Envelope Analysis (DEA) provided an appropriate framework for the analysis of the data that had been gathered, and provided a relatively robust set of data for benchmarking. However, it became clear to the authors that DEA also offered an important new method of approaching benchmarking, in which the data could be re-analysed to meet the needs and circumstances of a new user who wished to establish benchmarks appropriate to their own circumstances through an interactive interrogation of the data. The authors call this approach 'dynamic benchmarking', and describe the possibilities of such an approach in their conclusion.

The Case Study

The study reported in this paper started from a simple set of questions which appeared to be about benchmarking, and which, in retrospect, seem very simplistic. In association with other projects designed to encourage schools to grow vegetables locally for their school meals using organic methods, the present project was part of an effort to improve the understanding of where and how vegetable food crops are grown, the diet and the understanding of healthy eating on the part of young people. The present study set out to answer the question, what are the appropriate methods for ensuring that small plots of land are used effectively for growing vegetable food crops close to their point of consumption? This appears to be a very simple question, in the mainstream tradition of benchmarking. Since educational programmes do not have infinite financial resources, it would be important to know whether, for example, carrots, peas and potatoes could be produced locally on small plots, if not more cheaply than any alternative method of supply, at least within reasonable limits of cost.

Moreover, there appeared to be a good number of likely comparators in the area. Allotment holders, farmers with smallholdings – especially organic farmers catering for a local market – and specialist producers of vegetable food crops all operated in the local area, and appeared to offer the opportunity for benchmarking, and identifying the 'best of the best'.

The first surprise to the authors was that there are very few studies of this type, and even such simple questions as, "How many kilograms of carrots would one expect to crop from this piece of land?" are astonishingly difficult to answer. There have been some studies in England; in 1975 an experiment by the Royal Horticultural Society at Harlow Carr , a standard 333 m^2 allotment plot produced vegetable crops over the course of a year which would have had a value of £745 at 2004 prices for organic produce.(Stokes, 2005) Perez-Vazques (2002) reported a study of two allotment plots in London and one in Kent, and estimated a crop of 259 kg for each 188 m^2 area, with an average value of £400 at 2000 prices. Perez-Vazquez estimated this value by comparing with supermarket prices for vegetables produced by conventional commercial methods. Pretty (2001) states that in 2000 there were 300,000 allotments in England yielding an average an average of £1,870 worth of vegetables per plot annually. There are considerable differences in the three valuations of crops here, suggesting the possibility of inaccuracy.

There have been no detailed studies in Wales where the authors conducted the present research. It should be noted here that there is a surprising array of possible variables to include in such a benchmarking study, among which the high average level of rainfall in Wales in comparison with England is but one possible candidate. Rainfall in Wales varies widely, with the highest average annual totals being recorded in the mountainous areas of Snowdonia. The variation is between 750 millimetres and 2500 millimetres annually.(Brockway, 2005) Knowing what is an appropriate benchmark is extraordinarily difficult. Moreover, the studies conducted in England did not give an unambiguous answer to the question of how much produce could be expected from a particular area of land, and gave no indication at all when it came to benchmarking methods of vegetable food crop production.

As a consequence of these considerations, a survey was conducted of allotment holders and smallholders in Wales, in an attempt to identify what constituted good practice in the growing of vegetable food crops. Ultimately, this survey incorporated the responses of 40 vegetable food crop growers. This may seem a relatively small sample, but undertaking the interview surveys turned out to be very time consuming to collect the relevant data. With one or two notable exceptions, those who run small scale vegetable food crop enterprises do not keep accurate records of all their crops. Eliciting the data was therefore a question of in depth interviewing, ranging over the practice of the interviewees, asking them to remember, to estimate, and to evaluate their practical experience. For the most part the interviewees were busy with other things related to their crops, and not particularly committed to finding a general answer to questions that they address in much more immediate and practical terms. For these reasons it was not possible to rely upon postal questionnaires, and the collection of data from a single interviewee could involve a whole day of work, including the travel to meet them in person.

The result was a database of information about the conditions, methods and products of vegetable food crop growers in Wales. While the quality of the data was questionable in some respects, it was probably the best set of data on the issue in Wales, and therefore legitimate to use in a benchmarking study.

The most striking feature of the data, which included information on hundreds of variables describing the operation of small scale vegetable food crop producers, was the diversity of the sample that was collected. From the allotment holders who ate produce when it was ready, and coped with shortages and gluts by exchanging produce with other allotment holders or giving produce away to neighbours, to the smallholder who grew only one vegetable crop for animal feed, the range of activities seemed to cover every possibility. Some smallholders supplemented their income by running courses on their property. Some distributed vegetables direct to the public through local distribution networks, while others sold to restaurants and catering suppliers. Some allotment holders concentrated upon a few food crops, while others grew a little of everything, including fruit.

The original research design had been to conduct a statistical analysis using SPSS to identify the correlates of high levels of production. This, again, would have been in the traditions of benchmarking: which variables are the best predictors of high levels of output. It rapidly became clear, however, that because there were so many variables involved, identifying the correlates of high productivity would not be possible. With a sample size of 40, any correlation matrix drawn up to identify positive benchmarks would have more empty cells than full ones, and it would be impossible to arrive at any conclusions of any statistical significance. The authors therefore sought other possible frameworks to analyse the data, and selected DEA.

Data Envelope Analysis (DEA)

DEA is a statistical method in the field of operational research that is designed for tackling questions of the sort raised by this study. If a number of inputs and outputs of a process can be identified, then DEA permits individual units to be compared with each other to identify which units are most effective at converting inputs into outputs. In the case of the present study, we might identify a number of inputs – area of land under crop, labour, investment in tools and equipment, etc. – and a number of outputs – cash value of each of a range of crops (root vegetables, leaf vegetables, soft fruit, etc).

Taking each grower in turn, DEA constructs from the other growers an 'ideal' comparison which produces the same outputs, but uses the minimum of inputs. For example, if we consider the case of an allotment holder who grows 50 kilos of potatoes and 50 kilos of carrots. There may not be a comparable grower who produces this mixture of outputs, but DEA may construct a virtual allotment holder by combining one third of the activity of an allotment holder who grows 150 kilos of potatoes with one half of the activity of another who produces 100 kilos of carrots. The question then might be whether the grower being examined uses more or less labour than the virtual smallholder that DEA has constructed.

While conceptually fairly simple, DEA involves some complicated, iterative, optimising mathematics, and can be very difficult to visualise when many inputs and outputs are concerned. For this reason, a software package for DEA was selected for the analysis of data in this study. The package was Frontier Analyst, by Banxia Software. This is a sophisticated package that both conducts the DEA analysis, and permits further interrogation of the data, for example the analysis of which individuals have been used in the construction of the virtual comparator, and the weightings used in that comparison. Like all software packages, Frontier Analyst has the advantage of putting a huge computational resource at the disposal of researchers, in a way that was impossible only a few years ago. As with other packages for research analysis developed over the same time period, such as SPSS and nVivo, Frontier Analyst makes it possible for small research teams and individuals to use methods that were previously only available to very large projects.

However, Frontier Analyst shares with those other packages the fact that as the analysis becomes more complex, the interpretation is correspondingly more difficult. The intelligence that one should model one's behaviour on one third of the activity of A and one half of the activity of B is very far from the intuitively simple idea that best practice is 'out there' to be observed by anybody who looks. While DEA is a valuable benchmarking method, it does not produce a simple answer. We noted above that the study set out to answer questions in the form, "What are the appropriate methods for ensuring that small plots of land are used effectively for growing vegetable food crops close to their point of consumption?" What the study was demonstrating was that the answers were not going to come out in a simple format that could be taken away and applied, as might be the case, for example, with a prescription that more time spent weeding the crop would result in greater yields.

In the end, we concluded that, if DEA was an effective tool to analyse benchmarks, then it was not only undesirable to walk away from DEA with simplistic prescriptions for practice, but that DEA could be actively incorporated into the process of benchmarking, and of addressing issues of best practice. The authors call this process 'dynamic benchmarking', and will return to it below. But before examining the potential for dynamic benchmarking, it is necessary to review some of the shortcomings of DEA, and in particular the expression of those shortcomings in the present study.

Shortcomings of DEA

With a relatively small data set, and a large number of inputs and outputs, DEA has a tendency to indicate that all operational units are 100 per cent efficient. This is no more than a mathematical expression of the observation made in qualitative terms above that in a sample of 40 growers, the diversity of activity was extraordinary. A grower who grows only broccoli cannot be compared with a grower who grows only raspberries. When the data from those growers is analysed using DEA, DEA searches for a virtual comparator, finds none, and concludes that the raspberry grower is the best a raspberry grower can be and the broccoli grower is the best a broccoli grower can be. DEA therefore assigns a value of 100 per cent to the efficiency of those growers.

In the present study the majority of the growers undertook something unique; some specialised in herbs or cut flowers, while others organised courses, grew young plants for selling on, or concentrated on a niche market such as organic vegetable food crops. The majority of growers therefore excelled on one output, or in DEA terms on one dimension. This is enough for that grower to come out as being on the 'data envelope', the concept that gives its name to the method, and be a benchmark in their own way.

In practical benchmarking terms, knowing that everybody is excellent in their own way is not particularly useful. Incorporating multi-dimensionality or variety of purpose and diversity of outputs undermines the notion that there is an unambiguous 'best of the best'. On the other hand, if we go back to the original purpose of the study, there is a parallel between the original purpose of the study and the emerging understanding of benchmarking. Overall purpose or goal is not necessarily within the control of the grower, or at least set by priorities that cannot be reduced to efficiency.

For example, suppose that the study revealed that there was a single best practice for managing an allotment, and that the maximum crop could be achieved by growing cabbages one year, carrots the next, peas the third and then going back to cabbages. The authors could hardly go to a school and advise them that the best way to grow vegetable food crops for their own consumption on a small plot of land was to grow crops according to this pattern, and adjust their school meals accordingly. Benchmarking in this context looked like a rather different process, where a grower might ask, given a particular mix of outputs that they aimed for, how their practice compared with the performance of others. And the resulting picture would be likely to be complex. The application of DEA, therefore, appeared to enable a more subtle use of benchmarking, and one that moved away from simplistic notions of one best method of conducting the business of growing vegetables. However, a clear difficulty was going to be the encapsulation of straightforward conclusions without losing the subtlety of the analysis.

Within DEA, there is a trade-off between the number of inputs and outputs that are incorporated into the analysis, and the usefulness of the comparisons that come out. If the analysis of outputs is conducted at the level of individual crops (apples, pears, parsnips, carrots, tomatoes, lettuce, etc.) with 40 growers the only the result obtained is that everybody was excellent at doing their own thing. When the estimated value of the crops was aggregated under larger categories (soft fruit, root vegetables, leaf vegetables, etc.) then the majority of growers still showed up as 100 per cent efficient, and only two of the 40 compared poorly with their peers. Clearly, by reducing the number of variables in the analysis further the authors could have identified a smaller number of growers who would contribute to the ideal comparators – approaching the limit that with only one input and one output the study would have identified a traditional benchmark.

As with all analysis, the more coarse the aggregation of data, the less useful the results are in informing practical application. The authors therefore decided to halt the analysis at the intermediate level of aggregation cited above, even though it did not lead to a simple conclusion as to which grower, or small group of growers, in the sample excelled.

One of the most severe shortcomings of DEA is that there are no standardised tests of the robustness of the results, as there are, for example, with correlation studies. Thus while the researcher using SPSS has recourse to tests of statistical significance (even though those tests are frequently inadequate in illuminating the practical importance of a topic) in DEA there are no such tests. The only method of testing the robustness of a DEA analysis is a painstaking process of including or excluding individual cases or variables.

The authors conducted a good deal of this kind of *ad hoc* analysis, to see whether individual growers were having a disproportionate influence on the outcomes, and were convinced that within the sample the conclusions were fairly robust. However, there remains the risk, or opportunity, within DEA that a single new case that is dramatically more efficient on one of the existing dimensions within the analysis will dramatically alter the results. Since this possibility always exists, and cannot be removed by increasing sample size to any level below the level of the whole population, those who apply DEA are encouraged to think of any analysis as work in progress. This thought that new data might lead to a dramatically improved analysis also contributed to our thinking about how benchmarking might be developed into a dynamic process, in which analysis was incorporated into the process of application.

Finally, up to this point we have discussed DEA analysis of the growing of vegetable food crops as though it was absolutely unambiguous as to whether a particular element was an input or an output. This is not always the case. The simplest example of confusion over whether an item should be considered as an input or an output is the question of saving seeds. Very many growers who produce small quantities of vegetable food crops for consumption keep seed from one year to the next. This is an output from the current year, but an input to the subsequent year. However, treating it as both an input and an output means that it effectively disappears from the analysis, and the important practical question, of whether the purchase of professionally grown seed and F1 hybrids represents good value for money cannot be addressed. (F1 hybrid seeds are produced by careful crossing of two pure bred parents and, at a higher price, produce vigourous and uniform plant growth. However, saved seed from such crops usually produces worthless plants. There are exceptions, notably peas, beans and onions.(Cummins and Wan Ho, 2005))

This simple example can be resolved, however, by a simple decision on the part of the researchers, after sample analyses. Other discussions about inputs and outputs cannot be so readily overcome, especially where different participants have different perspectives. The allotment holder might regard the hours spent happily pottering about, leaning on a fence talking with other allotment holders, or the health benefits of exercise, as outputs, incidental outputs but outputs nonetheless, of the process of growing vegetable food crops. The smallholder who has to pay a farm labourer to perform the same functions might be inclined to regard those same, or similar, activities as inputs.

It is certain that in the present case study, the data on the time and cost of the labour input to growing vegetable food crops was the least reliable of any that was collected. But that was at least in part because different growers attached very different significance to the labour input, and therefore were by no means unanimous about its importance.

Again, returning to the original motivation for the present benchmarking study, it is clear that a school will have a very different approach to labour input than a commercial grower. While the school may not intend to increase the amount of pointless activity that the youth of the area indulge in, the process of tending plants will be seen as part of the educational development, and not necessarily something that needs to be reduced. A benchmarking study that concentrated on how growers might increase efficiency by reducing labour input would not necessarily be of any great value in the context of a school, or for that matter of an allotment holder.

This brings the authors to their final conclusion as to the desirable characteristics of a dynamic benchmarking process; those conducting the benchmarking should be able to specify which inputs and outputs are important to them.

Dynamic Benchmarking

In the process of conducting the DEA analysis, and in particular in the process of running one analysis after another in Frontier Analyst, it occurred to us that there was an alternative approach to benchmarking which would both be more useful, but also more directly adapted to the strengths of DEA.

If a new grower, not included in the original sample, wished to see how they were performing against their peers, their data might be included in the database of growers that we already hold. The new grower could then specify which inputs and outputs they thought were important to them. And finally, the whole analysis could be re-run.

The result would be a figure for the overall efficiency of the new grower. If that were 100 per cent, the new grower would be able to congratulate him or herself on doing a good job. But if the figure was less than 100 per cent, DEA offers a range of very important insights into performance. In the first instance, DEA has constructed a virtual comparator from one or more peers. This would make it very easy to pick out data from the database relating to those specific peers with whom the new grower should be comparing their own performance. Moreover, DEA identifies a number of ways in which the new grower might adjust their behaviour in order to achieve better performance in relation to those peers. While recognising that the new grower might not want to follow any of those recommendations for a host of reasons, or that some of them might be impossible to implement for other reasons, this would be a starting point for an analysis of whether the new grower might adopt different practices.

It should be noted that this process would be dynamic in a number of different senses. First, it allows the new grower to specify the criteria for the comparison, and the DEA analysis which ensues is thus adapted to their specific circumstances. Secondly, rather than being an end-point of a one-off process, benchmarking becomes the starting point for an analysis of possible improvements in practice (and subsequent further benchmarking). But, thirdly and perhaps most importantly from the point of view of further research, the process of benchmarking adds data to the database, and permits further improvements in benchmarking in the future. These improvements would come about in part because increasing the sample size would improve the robustness of the results. But with increasing sample size there would also be opportunities to increase the number inputs and outputs that could be used in order to make benchmarking more specific and of greater practical value.

In this new approach, benchmarking would no longer relate to an object, a gold standard of performance, but would be a process of improvement and development. While the literature on benchmarking certainly hints at such possibilities, pointing to negative ways of performing benchmarking, the authors do not believe that a process of dynamic benchmarking such as that set out here has been properly specified before.

Conclusions

In the process of the study described here, our thinking about benchmarking progressed through a number of reformulations. The authors started with the view that what was required was a simple answer, of the type, "A good crop of carrots will be x kg per square metre of land". The authors quickly came to realise that life was going to be much more complicated than that, as it was all but impossible to compare growers to arrive at a concrete result of that type.

The standard response of social scientists faced with such situations is to claim that the difficulty arises from the presence of too many independent variables, and to try to reduce the complexity of the description by using correlation analyses and / or factor analysis. Given the staggering diversity that was identified in even a very small sample, the authors quickly realised that this was not an option that was open to them, and that no results of statistical significance would be produced in that way.

The authors then adopted a DEA approach. While DEA has a number of serious shortcomings, it does achieve some of the results that the authors were looking for, in particular the capacity to handle diversity of goals and purposes. However, even with the statistical sophistication offered by DEA software, some of the intractable problems of purpose, and in particular the fact that different actors view the process of growing vegetable food crops in radically different ways, are not a feature of DEA, but are an outcome of the fact that the phenomena under study are not a single homogenous process.

However, having recognised that DEA allowed the authors to address a range of complex methodological issues with at least partial success, and also to recognise that the results of that process could not be summarised with a simple benchmark statement of the kind we had set out from at the beginning of the study.

The authors therefore concluded that the outcome of the study could not be simple benchmarks, in the form of statements of what outputs could be expected from certain inputs, as though individual outputs could be isolated within the complex process. Instead, it was concluded that a virtue should be made of necessity, and include DEA, not only in the analysis of the problem, but in the recommendation for a solution. The authors therefore propose a process of benchmarking where new growers can be incorporated into the database and analysis at the same time as, and indeed as part of the process by which, they are benchmarked. In the long run, such dynamic benchmarking might be achieved through an interactive website which would allow data to be submitted, criteria selected, and the outcome of analysis to be interrogated in individual ways. For the moment, the authors are simply stating that the outcome of the present study is a database and process which could be used as the foundation for a permanent, and self-improving benchmarking process, which could be handled with less sophisticated technology.

Overall it may be seen as something of a disappointment that the study did not arrive at simple benchmarks for vegetable food crop production, of the sort that would indicate how many kilograms of potatoes can be cropped from a plot of land. But the difficulty of collecting accurate data and the complexity of the analysis not only indicates that this would be a very much larger task than can be achieved by a small group of researchers in a limited time, it also casts doubt upon any claims to have achieved such simple benchmarks.

The point that the authors have now arrived at is not the end. It is not even, to borrow a phrase, the beginning of the end. It is, however, the end of the beginning. A database has been created, and a method has been applied which can, by repeated application and incorporation of new data, lead to a process of dynamic benchmarking that will address the question which the authors set out from. Such dynamic benchmarking practices could be used to ensure that processes incorporated into the curriculum are representative of best practice, and are efficient in terms of the se of resources. This applies equally to those processes such as vegetable food crop production that can be elements of the curriculum as to other elements which may be seen as more central to the educational process. The authors offer their experience as an example of how DEA and dynamic benchmarking can be used as a tool in developing and spreading best practice in educational settings.

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